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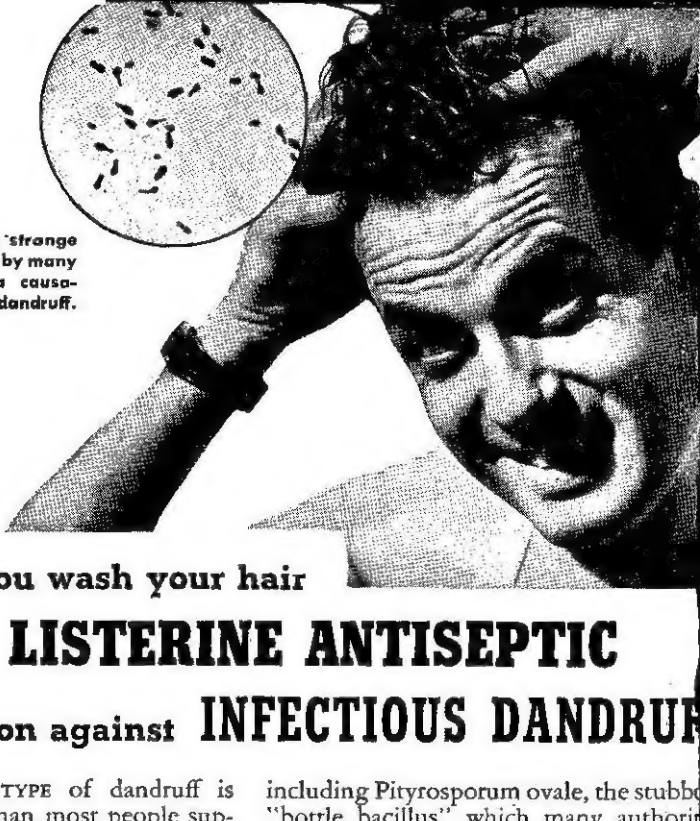
PATTERN FOR CONQUEST — BY GEORGE O. SMITH



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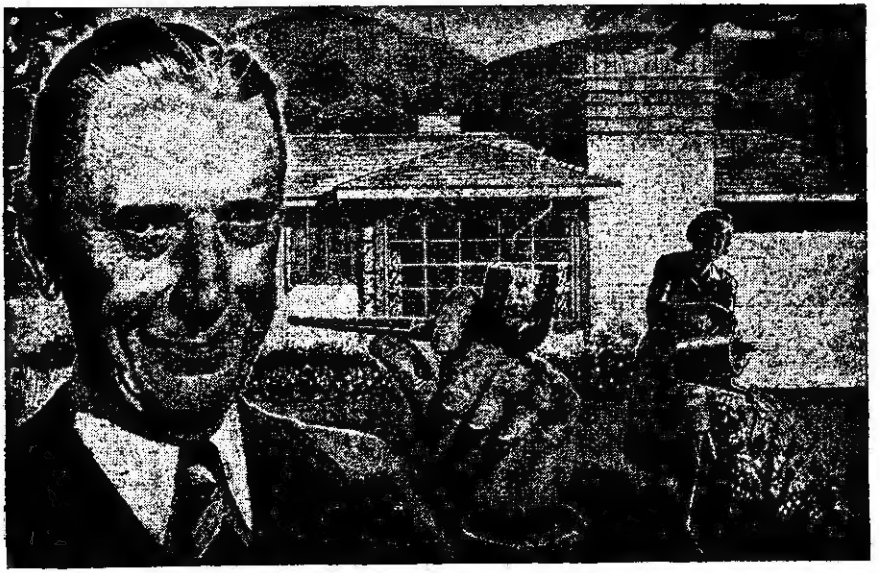

Let your HEAD take you

(The average American today has a choice of just going where "his feet take him", or choosing wisely the course to follow. Let's skip ahead 10 years, and take a look at John Jones—and listen to him . . .)

"SOMETIMES I feel so good it almost scares me. "This house—I wouldn't swap a shingle off its roof for any other house on earth. This little valley, with the pond down in the hollow at the back, is the spot I like best in all the world.

"And they're mine. I own 'em. Nobody can take 'em away from me.

"I've got a little money coming in, regularly. Not much—but enough. And I tell you, when you can go to bed every night with nothing on your mind except the fun you're going to have tomorrow—that's as near Heaven as man gets on this earth!

"It wasn't always so.

"Back in '46—that was right after the war and sometimes the going wasn't too easy—I needed cash. Taxes were tough, and then Ellen got sick. Like almost everybody else, I was buying Bonds through the Payroll Plan—and I figured on cashing some of them in. But sick as she was, it was Ellen who talked me out of it.

"'Don't do it, John!' she said. '*Please* don't! For the first time in our lives, we're really saving money. It's *wonderful* to know that every single payday we have *more* money put aside! John, if we can only keep up this saving, think what it can mean! Maybe some day you won't have to work. Maybe we can own a home. And oh, how good it would feel to know that we need never worry about money when we're old!'

"Well, even after she got better, I stayed away from the weekly poker game—quit dropping a little cash at the hot spots now and then—gave up some of the things a man feels he has a right to. We didn't have as much fun for a while but we paid our taxes and the doctor and—we didn't touch the Bonds.

"What's more, we kept right on putting our extra cash into U. S. Savings Bonds. And the pay-off is making the world a pretty swell place today!"

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NEXT ISSUE ON SALE APRIL 16, 1946

Progress To Be Made

Two things Dr. A. H. Compton said at the recent Nuclear Energy Symposium of the American Physical Society particularly interested me. The items are lifted out of separate parts of his address, but it seems to me that they fit together in the pattern of things to come.

The first was in connection with the subject of his talk, the social implications of nuclear energy. He pointed out that no one can possibly form a fair estimate of the possible influences of nuclear energy at this point, any more than men could, in 1896, immediately after Roentgen discovered the X ray, predict the social effects of that discovery. Some few effects were predictable then; within a few weeks of Roentgen's discovery the tube was being used in a Vienna hospital to aid in a delicate surgical operation. But no one then realized that X rays could be so devastatingly dangerous, could work cures on cancer, or that they would open a whole new field of science.

Dr. Compton's second remark was in connection with the rushing eagerness of the workers on the atomic project to get the job done. The very eagerness led to some heated arguments, for "everyone wanted to save the world as quickly as possible in the way he knew best."

Good will and good intentions are fine things; the earnest determination that the right things shall be done is very necessary. But a terrible lot of the world's miseries probably stem from just that eagerness to see the world saved as quickly as possible in the way each one knows is best.

As things stand at the moment, the only way nuclear energy can be released is by the use of either a moderated uranium pile, or by the use of purified fissionable material, either U-235 or Plutonium-239. Both methods involve the use of huge and decidedly detectable devices, contraptions no one is going to secrete in his basement, or in a backwoods shack. For the time being, the world is protected from the possibilities of nuclear energy by the sheer unmanageable bulk of the things.

But as we learn something of nuclear energies — science still doesn't have the foggiest idea of what that "nuclear binding energy" force actually is—we will find new ways of doing the job, and doing it better, more efficiently, and more compactly. To date, the only method of getting a bit of nuclear energy out involves shifting the nuclear particles—the *nucleons* as the physicists are now terming both neutrons and protons—around. We shift the 236 nucleons of the highly unstable U-236 formed by adding one neutron to U-235 into a new and more stable arrangement consisting of two lighter atoms, and collect the energy released in the process.

Obviously, such a system can work only when we shift certain

special arrangements into certain other special arrangements. It's a limited process, requiring highly specialized fuels, and producing a minute—relatively—return.

To do it right, we should simply annihilate all the nucleons. Turn the total mass into energy. When the trick of accomplishing that is learned, any mass—any kind of matter whatever—can be turned directly into energy. The atomic engine working on that basic principle can consume uranium, hydrogen, or steel scrap with equal, and total indifference — because any atom, whatever its chemical nature, is simply an assemblage of neutrons and protons. If your machine burns neutrons and protons as its fuel, the way they were arranged beforehand is of no import.

We can't tell how much the possession of nuclear energy as a research tool for studying nuclear energy will yield—but we can guess safely that we'll learn a lot, and fast. It's quite possible that methods of consuming nucleons themselves, directly, might be developed within as little as fifteen years. This rather high-powered rate of advance suggested can be compared with the facts that, in 1930—fifteen years before Hiroshima—the neutron was unknown, the cyclotron uninvented, artificial radioactivity had not been discovered, and uranium was an uninteresting element important mainly as a ceramic coloring material. Certainly it did not then seem likely that in a decade and a half atomic heat-engines would be functioning, and atomic bombs would have ended a war.

When small, use-anything atomic devices can be made, they can be made in secret. When they can be made in secret, some sincere, noble soul, a martyr to his own desire to save the world as quickly as possible in the way *he* knows is best, is going to commit suicide with some such gadget, and remove Washington—or New York-Wall Street, depending on his particular twisted philosophy — from the Earth. Lord knows, there are plenty of people around today in whom the spirit is willing, but the explosives are weak.

It's up to psychology to develop means of finding such unstable people and adjusting them to fit the world as it is. "It is later than you think" is a very applicable sentiment; psychology must advance faster than nuclear physics.

And I hope that someone, somehow, figures out a way to keep the newly developed powers of psychology from being used to "correct" the thoughts of people who don't need it. There might be some rather tragi-comic wars of psychological propaganda between such organizations as the militant W.C.T.U. and the normal members of the population who don't need, and don't at all want "correction."

Because there will always and forever remain that very real, very desperate problem that—"Everyone wanted to save the world as quickly as possible in the way he knew was best"—and with the very best of good intentions.

THE EDITOR.

Pattern For Conquest

by GEORGE O. SMITH

***Second** of Three Parts. With the aid of the Little People, Earth had developed new and mighty powers—but Earth remained one planet, and one people, opposing a quarter of a galaxy. The end was foredoomed—but the meaning was not so clear!*

Illustrated by Kildale

Synopsis

Stellor Downing, precise and calculating flight commander of Mars, is a bitter rival of Clifford Lane, quick and impulsive flight commander of Venus. Their rivalry is known to all three worlds of the Solar Combine, and it extends all the way from their clothing to rivalry for the favor of Patricia Kennebec, daughter of Co-ordinator Kennebec, the nominal ruler of the Solar Combine.

At the request of Toralen Ki and

Hotang Lu of Tlembo, known as the "Little People" from a distant world, Lane and Downing are sent on a mission together. To keep peace, Billy Thompson goes along. Lane and Downing vow to behave until the mission is complete—the Little Men require that Lane and Downing destroy a machine that is passing through space.

The machine—purpose unknown—is passing through the system of Sscantoo, which is populated by a race of feline evolution. The feline race are quite belligerent, and some fighting between the Solar forces and the catmen takes place. Lane is captured in the battle, and Downing retires to Planet One of the system to convert his weapons to those recorded and discovered in the fighting of the catmen.

Lane is successful in convincing the catmen that they are not to be diverted. The catmen are quite susceptible to Terran fungus growth and they fear the Terran's threat to drop fungus bombs if they refuse to permit the Solarians to search their system in peace.

The search continues, and the machine is found. It is a machine sent forth by the Loard-vogh, an all-conquering race that is bent on enslaving the Galaxy. It is intended to restrict the mental ability of the races through which sectors it passes. It has been in operation for twenty thousand years.

The machine is destroyed, and Lane and Downing go out to their long-awaited rivet-cutting, which is a game similar to the "How-close-can-you-come-without-hitting" game and quite dangerous. Their purpose is to make one or the other acknowledge that he is inferior.

Toralen Ki produces a mental machine that will now work, and Thompson and he discuss the plan. Thompson is told that Toralen Ki is to die willingly in an expenditure of mental energy. This wave will excite Lane's and Downing's minds, causing them to merge, creating twin entities each with double the mental power. To do this they are to willingly give up their identities. The surge of mental power from Lane and Downing will re-energize all humans.

Thompson, however, merely smiles and refuses to order them to stop. Toralen Ki inspects Thompson's mind and discovers that Thompson has been invaded by one of the Loard-vogh and his present purpose is to stop the Plan by killing Toralen Ki. As Thompson reaches for Toralen Ki, the Little Man snaps the power of his mental machine on full, and strives with the Loard-vogh for possession of Billy Thompson's mind. The battle is fierce, and much mental energy is being expended.

The recorder gives the information that dymodines have been fired and hits made. The battle between Toralen Ki and the Loard-vogh for the possession of Thompson's mind goes on regardless.

VIII.

Lindoo entered the crystal palace proudly. Not for Lindoo was the

belly-crawling approach to the mighty Vorgan, Lord of All. Lindoo was not a mere stripling; Lindoo was the head of the Board of Universal Strategy, and Lindoo had not only permission, but orders to enter but quickly, and tell but swiftly, anything that might possibly affect the future plans of the Loard-vogh.

Vorgan lifted a hand to silence the one upon the floor, his wish was conveyed by a man-at-arms, since the one on the floor was flat on his face, as befitted one of the lower caste.

"Urgent?" asked Vorgan.

"Perhaps urgent, but informative at least," explained Lindoo. "Kregar has made full contact with the Susceptible One."

"Susceptible One? Who may that be? Of what importance?"

"His thoughts are confused. His name is not pronounceable from the mixed thought-pattern. He is important. He was sent to maintain order between the Extremes."

"Ah—and K r e g a r has succeeded?"

"He has. But not without incident"

"Trouble?"

"Some. The Little Men of Tlembo have, in part, been successful. I curse them as you do, Lord of All. Yet the Loard-vogh must prepare and be always prepared for resistance. It is written that smooth sailing is a vain hope. The Little Men have carried out their intent. They have succeeded in harnessing the Extremes together—for a time. They have succeeded in destroying the suppressor—which is why Kregar was able to control the mind of the Susceptible One. Kregar is brilliant, Lord of All. Kregar deserves attention."

"If Kregar earns it, he will get it. I am not unjust, nor has any Loard-vogh been unjust. Tell me—his brilliancy?"

"Kregar learned of the rivalry through the Susceptible O n e. Through the latter, Kregar was able to set one Extreme against the other, fighting a mad duel to ascertain the better man. The intellectual apex, the Little Man known as Toralen Ki, the key to their future, is now being attacked by the Susceptible One, through Kregar's control."

"Excellent. And the outcome?"

"Obvious. Toralen Ki will die. So will his cohort Hotang Lu. Thus dies those who understand their intellectual limitations and the will to lift others above them. The Extremes, upon whom the Little Men pinned their hopes, will be split forever. One will certainly die—perhaps both."

"It is best. Shall we then attack the Planet of Terror?"

"It will not be necessary. Their possible danger to us is over."

Vorgan smiled, and he looked almost benign. He was a tall man, bearded, with a full head of hair that tufted white in patches. His ancestry? His classification? It is hard to say. He was vertebrate. He was warm-blooded. He was intelligent and he was more than dextrous with his hands. Both hands. He was also dextrous with his mind. The Lord of All had not become

Lord of All because of his heritage, his faith in deity, or his sheer ruthlessness. All helped, but the Lord of All was ruler because of his ability to rule.

"I'll witness the final act," he said.

"The reason I came—" nodded Lindoo. "Kregar is working madly, and yet there is interest there. It will be enlightening. For even the Susceptible One is most difficult."

The Loard-vogh at the instrument was sweating profusely. His hands were clenched, and blood ran from the center of the right fist where his fingernails had pierced his palm. His entire frame was tense, and his eyes were half-closed.

Vorgan looked, nodded, and spoke freely to the recorder beside Kregar. The Lord of All knew that the operative was concentrated beyond all physical stimuli. "The details, Neckal?"

"Lord of All, the battle progresses favorably. The Extremes—they are fighting each other. As you entered, the Susceptible One's mind indicated that there might have been a culmination to their fued. Two of their weapons have been discharged in a location that makes us believe that simultaneous death may have taken place. Toralen Ki is fighting for his life—"

Vorgan laughed. "Thirty-odd pounds against six times that mass! Lindoo, your operator has done well."

"Naturally," said Lindoo proudly. He could afford to be proud; he had picked Kregar.

"Yet I feel that we should do something about the Planet of Terror."

"You think—?"

"Sending out another suppressor will do no good."

"You are certain?"

"Not entirely. I just fear them. It is good sense to fear a strong enemy, Lindoo. We, of course, shall conquer, but far better to find them easily beaten than to lose ten billion of Loard-vogh's finest."

"The master plan does not call for invasion of that sector for twenty-four hundred years."

"I should hate to have my ultimate offspring cast slurs at my memory—and perhaps erect a statue to throw excrement at."

"But one cannot cover all dangers—"

"I know. Yet let us wait. It will depend upon Kregar's success."

Neckal spoke: "The battle progresses."

Vorgan frowned. "Why or how can one so small defend himself against one of the Planet of Terror?"

"The Little Man is agile and the Terran is clumsy."

Lindoo nodded. "We may both curse and praise that. If the Terran were less clumsy, he might well be more difficult for Kregar."

"Toralen Ki also has mental amplification."

Kregar's hands opened and closed convulsively. Once they clutched at a space near his belt, but closed as though in futility—what he sought was not there. He reached forward, and only Neckal's quick

action in turning Kregar around slightly prevented the Loard-vogh from clutching a delicate adjustment of the instrument through which Kregar worked.

Lindoo smiled. "It is written that a good big man will always conquer a good small man, my Lord of All."

"What lies between the Loard-vogh and the Planet of Terror?"

"Ten thousand light-leagues of space."

"A most dangerous spearhead—is it not?"

"It might be more than dangerous. To fight a war on many fronts is death. To warn a thousand races between the Loard-vogh and Terra might be the balance."

"Then we must hope," said Vorgan. "And only as a last resort will we drive forward."

"Face the fact," smiled Lindoo. "Kregar has—will have soon—the Little Man in his power. The cohort of the Little Man comes next. Dispose of them and the Planet of Terror will never know what it missed, in spite of the destruction of the suppressor. If nothing more than that happens, we are still safe. The Extremes fight one another—or fought one another. One or both of them may be dead. Grant the impossible and assume that Kregar is not successful and that Toralen Ki and Hotang Lu escape. Without the Extremes, releasing the mental torpor of the Planet of Terror will be most difficult.

"Now," continued Lindoo, with a very superior smile, "we grant the complete failure of our plans. All escape. Toralen Ki explains his plan to the Extremes. Have you any idea of sheer rivalry? Then consider your own attitude upon being asked to relinquish your identity to your most bitter rival."

Vorgan nodded. "How simple it would have been to wipe out all Tlembans so many hundreds of years ago instead of permitting those few to escape. I curse Mangare and I think I will erect a statue to his dishonor, that all Loard-vogh may spit at he who was not thorough."

Kregar's muscles tensed, wrapped him in knots, and his head jerked to one side in a spasm of pain. His eyes opened, glazed. They stayed open—wide and glassy.

Slowly he started, and with accelerated motion, he toppled to the floor. His frame went into one spasm, and he curled convulsively over his stomach. Then he stretched out straight and stiff.

"Dead," said Neckal, frantically.

"Dead?" echoed Lindoo.

"What happened?" asked Vorgan in a hollow voice.

"He failed."

"Failed?"

"How?"

"We may never know. But the failure was complete."

The Lord of All scowled. "Lindoo, plan the attack upon the Planet of Terror!"

"Yes, Lord of All. We shall strike Terra as soon as our forces can be deployed. It will take time, but we shall move with high speed."

"A word of caution, Lindoo. If

they do not embark upon the Plan of the Little Men, merely hold our spearhead force in everlasting readiness. I dislike this attack, though our numbers permit it. I'd prefer to stay closer to the Master Plan. But—if they change, attack!"

Vorgan returned to his throne room, to ascend his crystal seat. He waved for the serf upon the floor to continue, and the man-at-arms conveyed the Lord of All's desire because the serf still had his face to the floor.

IX.

Hotang Lu came at the call of his fellow. He saw the tableau. Thompson stricken rigid with mental effort, and Toralen Ki, tense and firm, before him. The Little Man's eyes were closed lightly, and his hands were clenched tight. Every muscle was tight in the mental effort, trying to drive the Loard-vogh out of Thompson's mind.

The waves of mental energy spread. Invisible and silent, they were not undetectable, for the men in the ships felt the waves of mental bleakness and strife and knew a deep and unreasoning fear.

Toralen Ki fought—and Hotang Lu stood by. To connect himself into the mental hookup at this point might destroy the balance. To destroy the balance might permit the hated Loard-vogh to enter, and no matter how brief the entry, it would be fatal.

So he waited, alert and ready to snap the transmentor over his head if Toralen Ki failed. He would give the Loard-vogh no chance to get set again; he would strike quickly while the Loard-vogh was still recovering from the headlong success. For in the moment of mental victory, the Loard-vogh's mind would be reeling forward like a man forcing a door that suddenly gives way before him.

Thompson's frame was rigid, his eyes open but glassy and—but they were not vacant. They were ablaze with an unreal light, the conflict in the helpless mind behind the eyes energized them.

But—the machine was destroyed.

And—there were waves of mental energy in the Terran's mind.

The conflict raged, and despite the helplessness of the Terran's mind and control, there was the untouchable subconscious that told him that he must fight for the beliefs he had always held.

His faltering breath strengthened. His rigid muscles freed, slightly, and the creases of sheer pain left his forehead. Still in fog, his mind scanned the mental data. Two forces struggled for control—of *his* mind. The thought came:

Hurl them out!

But one was—friendly—fighting for him.

The other was alien, inimical.

And with an effort of will, Thompson set his mind against the Loard-vogh, and with the efforts of Toralen Ki and Hotang Lu, plus their mental amplifier, Thompson hurled his weight of mind against the invader.

Thompson was annoyed, confused

and not too logical. To his mind, this was sheer pain, caused by the Loard-vogh. He hurled his hatred at the distant alien.

And the pressure of the conflict died. Thompson's body resumed its natural looseness, and the light of reason returned to his eyes. He smiled his usual smile and relaxed, breathing hard, and rubbing his temples with the palms of his hands.

The severe headache was leaving with noticeable rapidity. He faced the Little Men with an attitude of power and great will.

Hotang Lu stood in amazement.

Toralen Ki relaxed slightly also. They still faced one another, Little Man and Terran. But in their attitude was a vague feeling that they were fighting side by side.

And Hotang Lu understood. Toralen Ki intended to excite the minds of Lane and Downing by forcing them, psychological opposites, into mental contact. And he, Toralen Ki, was right now in bitter conflict with his own mental opposite—the Loard-vogh. The mental energies released in Thompson's mind had given the Terran the full and perfect control of his own mental ability.

They opened their eyes, both of them.

"Won," said Thompson, wiping his brow.

Toralen Ki inspected the Terran carefully. "You know, now?"

Billy nodded. "The rest of Terra and Sol must be excited. Wait—I must order Lane and Downing to stop."

The planetoid loomed larger and larger, and Downing crowded Lane closer. On approaching courses, it was becoming evident that the conjunction of courses would occur simultaneously with their arrival at the huge meteor. And yet Downing was the better off, for if he and Lane kept their courses doggedly true, Lane's ship would hit the meteor first. The carom, of course, would drive the flaming remnants of Cliff Lane's craft upward into Stellor Downing's ship, with the resulting injury to the latter.

Downing jacked up the magnification of his course-scanner with a twitch of his free hand. A rounded knoll of rock covered the scanner plate, and the cross-hairs that marked Stellor's course were just above and just to the left of the top of the knoll. A full-power shot with the dymodine in the right place—

And the caroming ship would deflect sidewise instead of straight up!

Stellor Downing trained the dymodine projector until the tiny circle in the course-scanner was still farther to the left of the top of the knoll than his ship's course.

The course-scanner in Cliff Lane's ship told him that he was heading for the knoll of rock. It would be a slicing blow, with Cliff's ship bounding up into Downing's craft. That much he knew.

Unless he did something.

He could drive up into Downing's ship right now. But that would be no solution as to whom was the better man. That would get Terra two corpses, but finely divided ones.

He could swerve.

And give Stellor Downing the right to say that he, Cliff Lane, had been bluffed?

Now if he were Stellor—?

Cliff Lane's dymodine sight was centered on the cross-hair of the scanner. He trained it slightly to the right and down, and then he touched the trigger.

Both dymodines blasted at once. Both beams raved out from positions one above the other, and both beams hit the knoll of rock in slightly different places. The splatter of energy from the coruscation ahead blinded both men, and set up shock-interference in the scanners.

A gout of flaming gas burst from the hit.

And within a few milliseconds of the hit, Cliff Lane arrived, with Stellor Downing almost on top of him.

Downing's ship hit the gout of flaming gas, and the velocity of ship was high. It deflected upward slightly, bending the spine of the little fleeter, rending a few plates, and dazing the Martian.

Lane's ship hit the flaming gas—which was almost homogenous where Lane passed through. The Venusite's nose plates dinged in slightly from the metal-to-gas impact. Right into the hit went Cliff Lane.

And out through the scar on the far side went the Venusite, roaring off in a halo of gases from the explosion.

They snapped radio sets.

"Well?" grinned Cliff saucily.

"Wise, aren't you?" grunted Downing.

"Try it again," advised Cliff. "I'm still spaceworthy."

"I'm buckled, but still capable," snorted Downing. "I'll be around—"

The ringing of the emergency alarm interrupted them. Thompson's voice came through. "Stop—at once!"

"Why?" asked Lane insolently.

"Don't even answer," scorned Downing.

"Stop, you fools. Stop—or Patricia Kennebec may die!"

Downing and Lane came around in tight arcs. As one they met on adjoining courses and raced like madmen for Thompson's command. They magnetted their ships beside the spacelock, breached it with the outside controls, and entered. They sent the door to Thompson's cabin slamming back against the wall and strode in.

"What's all this about Pat Kennebec?"

Thompson smiled. "It was about the only way I could stop that foolishness."

"Look, Billy, you've been interfering—"

"Don't be an idiot, Lane. Frankly I'm sick and tired of that schoolboy bickering of yours. As far as I'm concerned you can both go out and kill one another. But this is bigger than I am and it should be bigger than you are. Your job isn't through. We thought it was, but it is not. You, in fact, are just beginning."

"Quit talking in riddles and tell us what goes on."

"That machine restricted mental energy. It has been restricting mental ability for this entire sector of the Galaxy for twenty thousand years. It has been destroyed. But until the minds of Solarians are excited by a shock wave of mental energy, they will not have the use of their intellects fully and freely. You two are mental and psychological opposites, and the shock excitation of your minds in mental contact will excite the minds of all men." He turned to Toralen Ki and said: "I'm puzzled. There was sufficient mental conflict between you and the Loard-vogh to give me my release. Why hasn't it taken care of these two wildmen?"

"You mean the re-radiation from your mind operating on theirs as their radiation will free the minds of the rest?"

"Right. Why?"

"Lack of sympathetic tuning," explained Toralen Ki. "Your mind is unlike mine, and unlike the Loard-vogh known as Kregar, the one we fought and killed. Yet since you were at the focal point of the mental strife, your mind, untuned as it was, was excited by sheer brute force, so to speak. Selectivity could not keep out such sheer power. But selectivity would and did prevent re-radiation of the mental energy. You, therefore, have been freed, but no one else."

"Too bad," said Thompson critically. "It might have shoved some sense into their thick skulls."

"Hey!" exploded Lane. "He's talking to the Little Guy."

"How come, Billy?"

"You mean talking to him? Well, I was given mental release by a bit of a battle between Toralen Ki, here, and one of the Loard-vogh who was trying to control my mind."

"Give us more. You sound like a synopsis."

Thompson explained.

"Well, but how can you speak with him?"

Billy turned and asked Toralen Ki.

"You're surprised? Just as Lane and Downing will become mental twins, you, Billy Thompson, have gained twinship with my mind. Also that of Kregar, the dead Loard-vogh."

Billy smiled. "Simple enough," he explained to the pair. "After your minds are given release, you'll be able to understand him, too."

Thompson did not explain the twinship idea. Co-operation was one thing to explain, but the concept of accepting one another's personality would have to be given to them by someone who outranked them. Let them wonder—or even better, let them remain in ignorance, on the basis that what they did not know wouldn't harm Terra.

Toralen Ki shook his tiny head and looked puzzled, as well as shamefaced. "I didn't expect this," he said. "The concept of mental struggle between myself and another never occurred to me."

"It saved my neck," grinned Billy.

"And the collective necks of most of the Galaxy. And it is just as well that we didn't energize them, too. The main release for the solar sector must come when they go into

the change. Had they gone into the change out here, in Sscantoo, the mental radiation would not have been strong enough to trigger the minds of your fellows near Sol."

Thompson nodded and turned to Lane and Downing. "You two are going to have something to fight—but against, not over. That's been a private fight of yours for years. If you'd like to continue it, you'd better knock off the battle long enough to stop the Loard-vogh cold. Then you can resume personal hostilities and be damned."

"What about this Sscantoo?" asked Lane.

"They have some stuff that'll come in handy in fighting the Loard-vogh," nodded Thompson. "But we're not running off half-cocked. We're heading back to Sol right now, to make plans."

X.

Stellor Downing's hard fist came down on the table with a shattering crash. "I will not!" he said in a powerful tone.

"And I agree," echoed Cliff Lane.

Kennebec smiled patiently. "So far as I know it is the first time you've ever agreed on anything."

"The future—?" pleaded Toralen Ki.

Kennebec nodded at the Tlemban. "He's willing to die. He thinks enough of the future to die for it. You two might sublimate your lives just a little for it."

"Get a couple of others!"

"There are none suitable."

"What a stinking set-up," grunted Lane. "I've got to forget my identity and become a sheer hyphen."

"Look," snapped Downing, "it happens that you're sneering at my personality, remember?"

"I wouldn't have your personality for a gift."

"You couldn't—it's too big for the like of you!"

"All right," said Kennebec. "Stop it."

Toralen Ki said, sorrowfully: "I might have been dishonest, Co-ordinator Kennebec. I should have told them that the mental transformation would prove who was the better man."

"A convincing lie for the benefit of mankind is often better than the disquieting truth," observed Kennebec.

Thompson looked up. "What they need is to have their heads knocked together," he said sourly. "A fine rotten pair."

"Look," started Downing.

"Now listen," grated Lane.

"Shut up!" snapped Thompson. "You've both heard what Toralen Ki said. You know what's heading this way. You are aware of just what can happen on Sol if Sol isn't smart. And you sit there like a pair of flat-headed imbeciles, prating about your own petty fight. Patricia was right. It is a sorry day for civilization when it must depend upon the likes of you. Why don't you get smart? Where is your good sense?"

"You've no right—"

"Shut up!" snapped Thompson. "I have every right in the world and

by thunder I'm going to use it! It was funny, for years now, that you two were running all over your respective worlds, crowing like a pair of bantam roosters. The Favorite Son of Mars and the Pride of Venus! A bright pair of grown-up juvenile delinquents! Well, bright boys, civilization still depends on you."

Stellor Downing turned on Thompson and snarled: "No one is asking you to give up your identity. I haven't noticed any passion for anonymity in you, Thompson."

"You won't find any," gritted Thompson. He turned to Toralen Ki and asked: "Is there any way in which I may take either of their places?"

"Mine," offered Stellor Downing.

"Over my corpse!" shouted Cliff Lane.

"That I can arrange," ground Downing at Lane.

Toralen Ki shook his head, part in negation and part in the hopelessness of the situation. "No, on two counts," he said slowly. "One, your mind is not of an extreme nature. Second, your mind is already energized."

"Hm-m-m," mused Thompson. "Energized but still slumbering, I gather. Thanks for the tip, Toralen Ki."

He turned and bore his gaze on the battling pair.

"Listen—and carefully," he said.

"Why?"

"Because I tell you so," he said in a hard voice. "I'm tired—as everyone is—of your foolishness. I'll say no more about it. I've said my last." He opened his eyes slightly, and caught their gaze. He said nothing, but held their eyes as though what they saw must not be lost from sight lest disaster follow. For minutes he held them, and then he said in a quiet, low voice: "You will become mental twins. The battle for supremacy between you will and can become one of sheer mental force. You will each have that which you sneer at in the other. With all factors in the mind, you will struggle. Whichever of you is best fitted for existence under such circumstances will emerge victor. Understand. There will never be a public admission of mediocrity on the part of either one of you, for you will both change toward the one that is victorious. Now if you really want to finish that fight, this is a way to do it."

He turned to Kennebec. "At this point, they'll do it or I'll strap 'em both down—"

Toralen Ki interrupted. "They must enter it willingly."

Thompson looked the pair over. "Shall I call in the Interplanetary Press?"

Downing had been thinking deeply. He looked up and shook his head. "Lane, I'm willing to bet my mind against yours. Put up or shut up."

"Anything you can do I can do better—and faster!"

"Baloney. Toralen Ki can start right now, if the other half isn't afraid."

"Afraid—!"

"Well, are you?" sneered Downing.

"That doesn't even rate an answer. I'll take your mind over."

"Uh-huh. This time we'll have an answer. O. K., Billy. Bring on your devil-gadget and we'll play ball."

Toralen Ki looked about him, his face a mask. Stonily silent, he walked to the greenhouse and looked out over the landscape. He basked in the warm sunshine, and thought how much it reminded him of the bright sunshine of Tlembo. The buildings on the edge of the clearing were vast; Toralen Ki felt dwarfed by them, and he felt all alone and utterly alien in this world of giant beings.

A phonograph was playing somewhere, a piece of Terran music that suited the Tlemban fancy, and Toralen Ki was drinking it in.

The greenhouse was slid open in one section, and mingled with the soft phonograph were the myriad sounds of living. Faintly there came the raucous rattle of a rivet gun, the rumble of a sky train passing overhead on its way to the antipodes. He slid the section shut, closing the sounds of this alien world of monsters from his ears. He pressed a button and the steel shutter closed off the light that was so much like his own Tlemban sunshine.

It seemed wrong that such a familiar sun should shine down upon buildings of such vastness, glint against skycraft of such magnitude, and give warmth and life to a race so huge and so very, very young.

He turned and ran his hand over a bookcase. He touched a favorite volume, but did not remove it from its place. He had not the time.

He ran his hand over the tiny controls of his little craft. It had carried him so many light-leagues of space faithfully and well, following the dictates of his hands on the worn plastic handles.

End of quest!

This was it. He had come to the end of his search, the answer to his desire. This race would carry on where he and his race could not. The flaming torch—

Toralen Ki broke off with a bitter laugh. He was sounding slightly overdramatic to himself.

He faced them. Hotang Lu, who was looking at the blank wall with intent stare, and the Extremes, Lane and Downing, whose huge frames were cramped in the tiny control room.

Even here, they were. He could not escape them—and he admitted that he did not want to escape them. Yet he felt the touch of resentment. Unthinkable light-years from his home, surrounded and overwhelmed on every side with utter bigness—slumbering giants, all of them, awaiting the touch of his mind to awaken them to their rightful place.

It might have been Tlembo's rightful place were it not for sheer size and other natural factors. Why couldn't fate have given Tlembo that gift instead of this race?

But, time went on. And there was so little time—

Toralen Ki went to his desk and took a quick drink from the tall tube, and then inhaled the aroma

deeply. It had no smell to Terrans, nor taste, but Toralen Ki loved it for its powers—*not too much, Toralen Ki, you have a job to do!*

He went over and slipped the headset on.

"I'm sorry," he said. "I did want this last minute—"

He took up the hypo, inserted the needle in the vein of his arm, and pushed the plunger home.

Countless light-years away, Lindoo watched his meters rise higher and higher as he increased the penetration. Ever seeking, ever tuning, Lindoo strove to find another man whose mind was at balance and receptive. Given time—

And with a rush, all meters hit zero. A backlashing surge of power drove Lindoo back from his position. He turned and faced Vorgan.

"As with Kregar—" he started.

"Kregar died," said the Lord of All, ominously.

"Kregar died of mental overload. I received no such punishment. Kregar, recall, was in charge of the mind of the Susceptible One who thought of himself as Tawmpsahn. He was forced out and away, and pursued by Tawmpsahn and the Toralen Ki himself."

"So—?"

"Toralen Ki is dead."

"Good!"

Lindoo shook his head. "He did not die in vain."

Vorgan blinked. "They—?"

"I have failed. I have been trying to find another one to control. Those who may be controlled were in no political position to do any good— I found several others."

Vorgan nodded. "Time was short."

"I did not locate one controllable among those who might have done some good. And now I never will. The Extremes have joined!"

"And the shock wave?"

"Has undone all the good our suppressor did for twenty thousand years."

"Order the attack."

"Yes, Lord of All. The logisticians indicate a short period of mobilization and preparation. The Enilode Sector is being stripped of our men—they're not too hard to handle now—and a tenth of the men in all other sectors not actively fighting are being sent to the spearhead sector. I hate time. It takes so much of it to handle thirty million men and the supplies necessary for their support."

"That," grumbled Vorgan, "and the inoculations. A man undergoing them is a sick Loard-vogh for a week."

"Our initial attack may be some time in coming. But it will be complete, throughout that entire sector. We'll destroy the menace immediately, and from then on, all we'll have to do is to hold that sector against any possible enemy."

"A long and dismal prospect," said Vorgan. "But we must not give them time."

"They will have no time to do more than plan," said Lindoo. "It takes time to put a new skill into practice. We shall conquer them!"

"We shall conquer them," echoed Vorgan, the Lord of All.

"And we shall have to force the catmen, too, Lord of All."

"Why?" thundered the Lord of All.

"Because the catmen of Sscantoo are unsympathetic to all forms of alliance."

"They need never know."

"They will be told. Sol will ask their help."

"But . . I see," agreed Vorgan. "Being against all forms of alliance means that they will form an alliance, temporarily, in order to keep from being included in an everlasting tie. Yes, you are right. We may have to force them. But let us conquer Sol at any cost. And soon."

"As soon as we can prepare."

"Better cut the preparation somewhat. Let the initial attack come before full preparation. Only in that way will we gain time."

"It is a gamble."

"I know it is a gamble," agreed Vorgan. "But one must gamble if the Galaxy is worth the fight."

"I wonder if we could convince the Sscantovians that our interests— No, it would not work. I like not that idea."

"Sscantoo would demand proof. It is far easier to prove that we have been all-conquering than otherwise. An alliance with them could not be made. To do so would require that we give them full confidence. And we cannot control a quarter of a galaxy of Loard-vogh slaves so well that they must not speak. And their weapons are less efficient than ours —we could gain nothing but manpower which we do not need. . No, Lindoo, we must go forward alone as we always have."

Lindoo smiled. "We must be on the everlasting lookout for spies."

"We shall. I wonder if it would not be best to exterminate them completely."

"I could do it alone."

"I know. I wonder. They are a hardy race, though, and ambitious workers. Extermination—"

"Merely eliminates one menace."

"I don't think it would work."

"May I try?"

"May I have your head if you fail?" snarled Vorgan.

"Then I shall not try, Lord of All."

Vorgan nodded cryptically. "Losing faith in your own ability?"

"No. I merely have reason to respect your judgment."

"You are a true diplomat, Lindoo. Someday it will get you into trouble."

"When it does, that is a sign that I am not as good a diplomat as I thought I was."

"Or that someone has exceeded you, Lindoo."

"I might wear out—"

"No. When you fail, Lindoo, it will be because you have confronted yourself with your superior."

"And then?"

"Then the Lord of All will have a new Head of Strategy."

Lindoo laughed. "At that time I shall expect you to need one. Well, I must start preparation. I have much to do."

"You have," nodded Vorgan.

Throughout the lands and planets of the Loard-vogh there started a slow and gradual crawl. The forces of the Loard-vogh began to move slowly, like the rivers of the ocean. They could be felt; slowly and inexorably, though they could not be seen. Throughout a thousand suns the soldiery left their billets in twos and threes. They bade good-by to their temporary homes, kissed their slave-lovers and serf-women farewell and faced new fields. They collected along the frontier, planets full of brawling Loard-vogh that swarmed like the all-consuming locusts. They fought among themselves. They stole and they looted, and they took souvenirs of value. Native women—some of them the intellectual superiors of the Loard-vogh—were not safe on the streets, and the fighting was not without its overwhelming toll of innocent bystanders.

Somehow it was very few of the Loard-vogh that got hurt.

And the planets began to pile deep with equipment. It was a real springboard, this planet frontier. Like a storm cloud collecting electrons, they would pile up to the bursting point and then with a crackle and a flash of lightning, they would hurl themselves across space to blast the focal point.

Terra!

XI.

Cliff Lane and Stellor Downing faced one another. They had spent hours in complete slumber after the incident, and their awakening had been almost simultaneous. They were both in a mental tizzy; they knew that Something Must Be Done but were slightly foggy as to what. Their former animosity seemed gone, or at least secondary to the urgency of the present situation.

They did not ask the usual question upon awakening, they knew that they had been removed from Toralen Ki's ship and hospitalized.

They did not mention Toralen Ki —not openly. But they felt it. Perhaps it was a sort of mental maturity, this Transformation. They kept their counsel until they could discuss it together — and they seemed to know that the other preferred it that way.

They sought the eyes of the people in the room and asked, almost simultaneously: "Can this be explained now?"

Hotang Lu nodded agreeably. He explained the story in full, and completely. As he concluded Hotang Lu smiled again. "Before—you had not the ability to understand, nor had I the ability to express myself in your terms. The Transformation has made it possible for all of us to partly speak in the other's language, and partly c o n v e y thoughts."

"That should be helpful."

"You will find it so. No matter which race of whatever sun you visit in the future, you will find that faculty helpful. You will even be able to mingle with the Loard-vogh."

" 'Mangle' sounds better," gritted Lane.

"That will come in time."

"Well, let's hit it," said Lane.

"What do we do first?"

"First," said Hotang Lu, "is to beware. The Loard-vogh are warned. Knowing their psychology, attack will be imminent."

"Then we'd best prepare to repel boarders?"

"Yes."

"Hotang Lu has the right idea," said Lane. "If they're warned, they'll clip us first."

Kennebec objected. "Why?" he asked. "Why do you expect them to hit us? After all, they're swarming through the galaxy in this direction. If they are that powerful, why should they attack Terra?"

"We constitute a threat," said Downing. "We are a powerful threat, or I miss my guess."

"Terra is a most powerful threat," said Hotang Lu. "Terra, well, it is known to the Loard-vogh as the Planet of Terror."

"Gratifying in a nice, lethal way," smiled Kennebec. "Mind telling us why?"

"Not at all. Terra is the center of the mutation area."

"Meaning what?"

"Sol is one of a vast trinary, astronomically speaking. Or was once. It is now one of an extended binary. You have no reference to this?"

"Not that I know of," said Lane. "And I've been a student of astronomy."

"Well, it is so vast that you may probably not come to the astronomical proof for thousands of years. Sol, however, is one of a binary that used to be a trinary. The third sun was alien—contraterrene. Thirty million years ago it was struck by a stellar wanderer—of terrene matter. The explosion was mighty. It was vast. It scattered particles of the third member far and wide. A great swarm of bits of contraterrene matter range this sector of the Galaxy. They fall into Sol, into Alpha, into Procyon, into Sirius, into the other stars within thirty to forty light-years from Sol. Even Arcturus, forty light-years away, has his small share, and so it goes.

"The resulting radiation from this drift of contraterrene matter falling into the star dispersion of this sector has bathed this entire portion of the Galaxy in hard radiation. Mutation has been rapid, and evolution has taken swift advances."

"Meaning exactly what?" demanded Stellor Downing.

"I can tell you that one," laughed Thompson. "We are tougher than hell."

"Terra's evolution has been vicious and swift," said Hotang Lu. "The natural enemies of life have also evolved rapidly. Clifford Lane destroyed one of the minor animals of Sscantoo by merely holding it—so did Stellor Downing. The things that Terrans live with in peace—or even symbiosis—are feared by the rest of the Galaxy. Insect life—many thousands of kinds of insects. Fungus—a myriad of types, all hardy. I've heard of a mollusk that secretes strontium metal for a shell rather than the usual calcium, and micro-animalcules that thrive in a bath of chemically pure sulphuric acid. Terrans drink a most foul poison—ethanol—for pleasure.

and inhale the combustion-products —tar and worse—of a dried weed as a fairly common habit. This habit, by the way, seems to have absolutely no effect upon life or mentality. Terrans go anywhere with immunity, and those who come here must prepare to die."

"You're not dead," objected Lane.

"No, but I expected death. I was prepared. I was innoculated and sterilized and given all sorts of treatments. I irradiate myself daily with the micro-organism killing radiations known to our doctors and scientists. Otherwise I would—well, in your slang terms—grow green hair in an hour.

"In fact," continued Hotang Lu thoughtfully. "Toralen Ki and myself were the last of several expeditions to contact Terra. We sent a first to investigate and sample the upper stratosphere. They did—and they died painfully. But they succeeded in preparing artificial antimeasures against the bacteria and fungus-spores that roam that altitude. The second expedition landed, but took only samples of the surface-atmosphere. They died, learning the secrets of the mutant microlife of Terra. They prepared antimeasures for the third expedition who emerged from the ship, protected against air-borne death, and gave their lives learning how to control the microlife that abounds and is transmitted by contact.

"The fourth expedition came to roam the planet at will, and they died because there had been a mutation in one form of spore in the years between the third expedition and the fourth. The fifth came and were safe.

"Toralen Ki and myself were the fifth expedition."

"Um-m-m, what a nice bunch of little stinkers Terrans must be," smiled Lane.

"Terrans and Venusites," amended Downing.

"Don't be bitter," laughed Lane. "You're tarred with this brush too, you know."

Kennebec smiled. "I'll be afraid of myself from now on."

Hotang Lu looked at Kennebec seriously. "That is your main concern," he said. "You—and all Solarians—have but that to fear."

"What?"

"You need fear only yourselves. All your other enemies fall like the wheat before the scythe. From the most minute to the most gigantic. Micro-organisms that defy your best instruments can not defy your evolution. Giants that defy your imagination can not defy your science. The cold and forbidding planets themselves bow to Terran domination. Lane, born on Venus; a world of violent insect life and rife with micro-organisms is populated by Terrans. Downing was born of Mars. Mars is cold and forbidding. Life cannot survive there. Life cannot, gentlemen. Oh, life in the sense that regeneration and self-sustenance is life, can. After all, Mars is bathed in the same radiation that produces hardy mutations. But Terran life is intelligent. Martian life can not be—"

"See?" chortled Cliff Lane.

Hotang Lu swung upon the Venusite. "Stellor Downing is Terran," he said stoutly. "Venus can not support intelligent life either," he added in a mollifying tone.

"They do," objected Kennebec.

"By support I mean spawn," said Hotang Lu. "To support does not mean to 'be converted to'."

"Oh."

"Terra controls. Terra takes

over. Terra is the Planet of Terror. Her minions rule the Galaxy, her mutants are the fear and the death of all. Linzete of Sscantoo capitulated because of two things. One was Lane's ability to carry, without self-destruction, micro-life that destroyed their minor animals in a matter of minutes. The other was Downing's ability to read the radiation of their weapons and return in less than a month with an improvement on them. And what is your favorite dish?" he asked Kennebec.

"Filet mignon with mushrooms."

Hotang Lu shivered visibly. "Tender, of course?"

"Tender and very, very rare."

Hotang Lu shivered again.

"Why?"

"What makes a steak tender?" he asked with an air of innocence.

"Brutally speaking, it is a matter of semiputrefication."

"Precisely. You hang it in a warm, smoky, damp place until it 'grows hair'. Then you partially cook it—not really enough to destroy the enzymes—and smother it with one of the most pernicious forms of fungi. It is served hot—a condition that enhances most chemical reactions. And you fall to, eating this deadly mixture with appetite, relish, appreciation, and, by the most holy, you complain bitterly if the tenderness is not right. You object if the micro-organisms have not had their chance to break down the toughness of the meat. About the only disease that Terrans really need fear is the ulcer, which is a case of the adaptable beginning to eat itself, or perhaps carcinoma, where local mutation takes place."

"That makes us feel very good," said Kennebec dryly. "But from what you've told us, we are on the brink of invasion by a super-race that is slowly engulfing the Galaxy."

"The Loard-vogh must be defeated."

"I should think so," remarked Kennebec.

"Our work is through," said Hotang Lu. "Tlembo is surpassed. Sscantoo was one hope of Tlembo, but the catmen are almost at the peak of their evolution, and cannot be increased in mental stature more than twice or thrice. Tlembo reached their mental ultimate ten thousand years ago and were far surpassed by the Loard-vogh. Terra now surpasses the Loard-vogh. But remember, Co-ordinator Kennebec, you have mental *ability* not real mentality. You have the capability to increase a thousandfold above your present mental stature. But you have not increased in fact."

"I do not follow."

"Your infants have the ability to become the mentally great. Until that ability is exploited, they are mentally lower than the most unintelligent of animals. They cannot even feed themselves without help.

"Terra now has the ability," he continued. "If Terra is to rule the Galaxy—and well she might for her adaptability—she must exploit the latent mental capability."

"And the next plan?" suggested Kennebec.

Thompson looked at Hotang Lu. "What's yours?" he asked.

"You will be the co-ordinator. The Extremes will co-operate in gathering information and you will direct them, and all of Sol, in this effort."

Kennebec frowned. "You must know what you're doing," he said. "But I was under the impression that Lane and Downing—?"

Hotang Lu nodded. "That was the original plan. But due to a rather peculiar set of circumstances out near Sscantoo, Thompson now has the superior mind of all Solarians. You see, he did not achieve twinship with a Terran. He achieved a . . . er . . . *tripletship* with Toralen Ki, and the Loard-vogh known as Kregar, who was high in their councils. Since he is aware of the Loard-vogh mind, his decisions can be expected to take into account what they are likely to do."

"One of the main jobs in fighting an alien culture is to try to outguess them," added Thompson. "Having a bit of Loard-vogh psychology for inspection will enable me to handle the outguessing process somewhat better."

"Reasonable," agreed Kennebec. "My job now will be to convince the superior officers of these three that their ability warrants giving orders instead of taking them."

"It should be easy. Their ability will speak for itself. Besides, you may issue statements to the effect that mental activity between these three have placed them—"

"Hotang Lu, a thousand years from now we might. But you told us that all we now have is the mental *ability* without the training necessary to use it."

"Yes?"

"My small friend, all that means is that men will now be able to use the whole of their minds to indulge in power-grabbing, connivery, and politics."

Hotang Lu smiled. "I know," he said. "The end-product of it all will be that little change is visible. You see, the avaricious of your race will be of greater mental power, true enough. But those of you who try to see that things are run right will have the same increase in mental stature. When I spoke of the human race as a slumbering giant, I meant that all facets of human nature were equally smothered."

"Hm-m-m. I see what you mean. But jealousy isn't good, and if I make a statement to the effect that the minds of these three are superior, every mother's son on all three planets and nine colonies a-stellar will be sharpshooting for them. Ah-hah," he finished, shaking his head.

"Their ability will take hold. Their individual characteristics will show. Let it be known that Lane and Downing are each doubly capable because of the mental twinship. That all Solarians know now. Let it also be known that Toralen Ki and the Loard-vogh Kregar fought the same type of mental battle for Thompson's mind—and that he has the triple ability. Regardless of jealousy, they will come out on top."

"Well," said Thompson, "at this point I think we'd best be thinking

about our skins. Cliff, like to scout the catmen again?"

"What for?"

"Take a look at their stuff. That snatcher they had might be the stuff for trouble in a large scale. Might see what they've got, and what you can make of it."

"Think there's any chance we might grab a hunk out of the middle of a sun and hurl it at the enemy?"

"Yes, but it is remote, and wasteful to boot."

"Why?"

"Anything you might grab out of any sun would be more difficult than grabbing the planet itself—the one you want to annihilate, I mean. Better do it directly by just taking the planet, stopping it in its orbit, and hurling it to its sun itself. The forces present in a sun would be more difficult to handle. And besides, what would you anchor it to?"

"Space itself," suggested Downing. "With a driver beam."

"You'd end up by warping space. Nope, I can think of easier ways of beating out my brains. But Cliff, if you'll see what they have, we can use it, perhaps. Stellor, any suggestions you'd like to make?"

"Someone better start converting the manufacturers. Hotang Lu's picture isn't at all good, you know. The Loard-vogh have conquered about a quarter of the Galaxy now. Their numbers are legion and they are a conquistadorial outfit at best. They'll fight to the last one, and they outnumber us thousands to one."

"Millions," corrected Hotang Lu.

"Looks futile right there."

"Let's not quit before we're licked," snapped Thompson. "Before they collect Sol in their list, they're going to have to kill each and every Terran."

"Um-m-m—not a bright prospect."

"Makes us as tough as they are," mused Kennebec.

"Tough, but not as nasty," offered Billy. "They want conquest for the sake of conquest. They'll die to the last man fighting for the sake of fighting. We'll die to the last man fighting for peace."

"Right."

"So," offered Downing, "I'll take a scout of the Loard-vogh if you want."

"O. K.," said Thompson. "This is going to keep us all busy for a long time. We'd best relax tonight—tomorrow we can all leave."

"You'll take my crew?" asked Stellor Downing.

"Since spying can't be done with twenty-five ships at your back, I will," agreed Lane.

"You can handle 'em," said Downing. "After all, you do have my ability now."

Lane smiled cheerfully. "O. K. I'll see you later."

"Right," said Downing.

"And keep this under your hat, fellows. Terra has one great secret weapon that the Loard-vogh can never get nor use. It is a weapon that must wait until the time is ripe. It must never be disclosed, until it is in use. Then—it will be too late for the Loard-vogh to stop it."

"What is it?"

"If you don't know, I'll not tell you yet."

"But why tell us at all?"

"The idea of fighting a race that has conquered the Galaxy is staggering. Especially a race that, until lately, has been Terra's mental superior. The knowledge of a secret weapon of definite capability tends to make our battle less foolish. We will win."

XII.

Patricia Kennebec peered out of the window at the screech of brakes on the pavement. Then, to avert open hostility, she ran to the door and out upon the sidewalk.

She faced them, and was slightly baffled to hear them speak:

"Well?" asked Lane.

"You didn't beat me."

"It was a dead heat," smiled Lane.

"We're two minds with but a single thought, these days," Stellor told Patricia. "Every time I find myself thinking of something, I discover that he has been considering the same thing, too."

"You'd better split your personality—and/or your body," suggested Lane. "Or become twins. I can foresee difficulties with the theological and civil authorities if this goes on."

Patricia smiled. "I can't possibly marry you both. Not at the same time, anyway."

"Toss coin?" offered Lane. "We'll take turns—"

"You will not!" stated Patricia. "I'm old-fashioned enough to go into it wanting permanency. I don't really expect it, but I can and will hope. I will not enter marriage with any split in mind. That's . . . that's—"

"Sorry," said Cliff. "I was joking."

"Love may be somewhat amusing," she said seriously. "But marriage is no joke. So let's forget it. Oh—look! Here comes Billy!"

Lane and Downing looked, and then whistled.

Patricia squinted at the pair of them, and then took another look at Thompson. "Did you two swap minds—or was he in on it?" she asked with a laugh.

"He wasn't—but why?" asked Lane.

"Billy is pulling your favorite trick," she told Lane. "He's got a glamor-puss on each elbow."

"And he can pick 'em, too!" said Downing approvingly.

Patricia looked at him in puzzlement.

Lane caught the look. "That's my line," he told Stellor.

"So it is. 'And your line shall be my line, and your ideas shall be mine. For whitherso thou goest, there—' and so on, Cliff."

"This is getting bad," smiled Patricia to Billy. "I've often thought that it would be perfect if I could take these two and boil 'em down into one man. Instead, I've got the boiling process done but the outcome is two men both with all of the things I've liked about each—or am I getting involved in my own words?"

"I knew they'd not think of furnishing enough femininity to make a full party," he laughed. "Patricia, smile and be nice to all

of us. Kids, Patricia Kennebec. Virginia Thompson, my sister, and Tania Lake, her erstwhile college chum. Gals, the redheaded wildman is Stellor Downing and the dark, sunkissed Adonis is Clifford Lane. Take it from there."

Lane blinked at Virginia. "You're *his* sister? By adoption, no doubt. No blood relation of Billy could be—" Lane stopped at precisely the right point, and looked just the right amount of confusion. His act went over, and Virginia smiled back. "He talks, too," he said seriously.

Patricia Kennebec looked at Billy. "This has the earmarks of conspiracy," she told him. "What gives?"

"Nothing in particular," he said with a slight smile. "Ginger and Tanny were sitting around the house as usual when I got home this evening, and both of them looked hungry. Seems to me they're always that way—at least as far back as I can remember."

"You mean you've been concealing assets like these?" demanded Downing.

"I'll inspect this conspiracy a little better after I find out how it's working," Patricia whispered to Billy. "You treat them both like sisters."

"Tania has lived next door to us for most of her life," said Billy honestly.

"Hm-m-m—g i r l h o o d sweetheart?"

"Nope. We didn't even scrap over the back fence."

"There's one thing about Billy," said Downing, diverting his attention briefly. "He doesn't ever scrap for anything."

"He never seems to lose anything he wants," offered Tania.

"He doesn't," affirmed Lane. "Trouble is with that kind of guy, he'll never win the Solar Citation. Billy, why in the name of sin don't you make something look hard, just for once."

"I claimed that any man who could spend a couple of months as referee between you two would have a job big enough to win the Solar Citation," said Patricia.

"He made a breeze of it," said Lane, and Downing nodded and added: "Every time we got to the shooting-point, Billy was there with a crisis to solve, a mission to perform, or a detail to handle. And when the rivet-cutting really got going, he thought of the one short statement that stopped us both—cold."

"I still say getting in between you two is bravery above the consideration of personal safety, or even the safety of any individual, for the benefit of mankind. If that doesn't rate a Solar Cit, I don't know what does."

Billy grinned brazenly. "It all comes of one idea," he told them. "And that's the little proposition of making the best of what you know. I—know people. So I can make 'em tick. I'll admit it, I'm brilliant. Now let's forget my obvious touch of genius and go somewhere and try out our own individual superiority against a steak. We'll

weigh the remains and the largest leavings is a loser."

From the front steps, Co-ordinator Kennebec called: "A good idea, fellows. I was about to call out the Guard. I was beginning to think that a mass meeting was going on right on the Presidential Grounds."

They waved good-by, and drove off in Billy Thompson's car.

And it was about four o'clock in the morning that Hotang Lu retired after hours of discussion with Kennebec. The co-ordinator of the Solar Combine nodded the Little One to his door, and then decided to raid the presidential icebox. He stopped at the door.

Co-ordinator Kennebec had a large and healthy respect for Patricia's judgment, though she was but a youngster according to his standards and those of his contemporaries. Perhaps the combination of Irish impulsiveness with the Canadian-Scotch horse sense had resulted in something with a better grasp on human nature—or perhaps it was that still-unknown intuition that women all claimed. Anyway, Kennebec had been talking to Hotang Lu with four tenths of an ear cocked to the doorway. He'd wanted to get Pat's side of the details.

He'd missed her, apparently.

For if any icebox were raided, especially the austere icebox of the co-ordinator's presidential home, it would be done *en trio*.

Kennebec grinned. He hoped they'd leave some for the nominal ruler of the Solar Combine.

The idea of ordering out an aide didn't occur to him; an aide could produce anything at any time, but Kennebec wasn't the type to impose. He'd do his own icebox raiding!

But he was not beyond a bit of diplomatic eavesdropping. He'd thought of Pat's problem, too. Twin minds between the men she preferred impartially. That—and he didn't like to consider it—reduced her selection to the sheer animal. He was not euphemistic, nor blind, and he recognized that men and women will be men and women and that physical attraction was a major factor. But he was of an intelligent race, and he knew also that sheer physical attraction without a simultaneous mating of mind usually resulted in trouble.

He wondered—which of the pair of worthies had the greater physical attraction for his daughter.

So, with no feeling of shame about it, Co-ordinator Kennebec, nominal ruling head of three planets; elected by popular vote; empowered to act by the Solar Combine Congress; commander in chief of all armed forces of three worlds—e a v e s d r o p p e d on his daughter.

"Just a keyhole listener," he thought. "I wonder which—"

"That was a neat piece of business," Pat laughed.

"Was it?" answered her companion.

"It was. And you know it. A neat bit of skullduggery."

The laugh that followed was very masculine—and there was no mistaking the originator.

"May I ask what the idea was?" asked Pat.

Billy Thompson's well-modulated voice answered: "Sure, I'll tell you. Do you want it right off the shoulder or will you take it by degrees?"

"I can take it," said Patricia. Her tone was light, but undertones of softness were there. "Can you dish it out?"

Kennebec swallowed. Billy Thompson! Whatever he had done, he'd done it well. Kennebec smiled wistfully. Any man who could cut Patricia out of the tight-pack between Lane and Downing was either overly wise or—

"I'm dishing," said Billy. "I've been wondering how it would be to have you all to myself."

"Have you found out yet?" asked Patricia lightly.

"Not yet—it might take a long time."

"It's four o'clock," she told him.

"So what?" he said hotly. "If I get a card to this game, it's going to be a hard-held one."

"You mean that now I'm confronted with the idea of deciding between three of you?"

"Patricia, this is big-league stuff. Sit around and get as egotistical as you want. I don't think you are. *I* think a lot of your confounded superciliousness is just an act—and I intend to find out!"

"An act, Billy?"

"Pat, I hope it is. How long has your dad been co-ordinator?"

"About seven years."

"And you're twenty-four."

"Been reading my mail?" she asked, raising an eyebrow.

"I can—and often do—read newsprint."

"Oh, you read, too?"

"Shut up," he snapped, "and stop sounding like a character out of a bum play. You know what I'm trying to tell you. You've been the high priestess of this chateau ever since you were seventeen. D'ye know any seventeen-year-old that has any sense?"

"Ah—"

"I know," he grinned cheerfully. "Patricia Kennebec at seventeen."

"I've not been here—"

"No, you've been to college, and stuff like that where people have been kowtowing to you. Well, either you have that glazed-personality for self-protection *or I wouldn't have you on a bet!*"

"Huh?" asked the girl. And her father swallowed, took a deep but silent breath and wondered what next?

"Wonderful woman," he laughed. "Three of the top men in the Solar Guard chasing after you. Gives you quite a feeling of superiority, doesn't it?"

"I—"

"Don't answer, Pat, you're about as responsible for the antics of that pair of concentric idiots as anything else."

"Look, Billy, Cliff and Stellor at least were honest with me. I knew

them before I ever met you. Years and years ago. They fought over me for the junior prom in high school. They ganged up and took me, *en trio*, to the graduation party from grammar school. And both of those were before dad was mentioned as co-ordinator-possible. That, Billy, was before I became a possible key to the co-ordinator's office. All right. I sound jaded. I'm a stinking little headstrong, egocentric brat that sits around dangling men from a nylon ribbon, playing hearts. Billy—*how can* YOU *prove that* YOU *don't want something?*"

"Huh?"

"How is a nonomniscent human being in my position to know a protestation of affection from a pure and perfect act—the purpose of which to gain something?"

Kennebec, standing in the silver closet, bit his lip. He'd see this thing out, for he wanted to ask Patricia a question. For once in his life, he was not certain of the *rightness* of his ambition. Patricia would know. Was all ambition foolish? Is this what they meant when they said: Of what use to gain the world if only to lose a soul? Had he in his ambition to give his motherless daughter the best of everything, deprived her of that one thing that no one could do without? To have friends, even lovers, whose protestations of affection were honest; whose need of her was as personal as her need of them? How had she learned, at a tender twenty-four, that there were those who would present false face for position—and take, perhaps, that which—?

Kennebec smiled shyly, in the darkness. She had learned. Apparently it had been hard, but not too hard, that learning.

"Patricia," said Billy. "Patricia, listen to me. I've not known you long, compared to the—wildmen." He laughed shortly, but it was forced and she knew it. So did the man behind the door.

"I've not known you long, Patricia. I did a bit of trickery tonight. I dropped two red herrings across the trail—"

"Make it good," whispered Patricia, "or I'll tell the girls what you called them."

"Basically, I'm honest," said Thompson in a cheerful voice. "I bribed them well. Their known and accepted jobs were to sidetrack the un-heavenly twins. Both Ginger and Tanny swore that nothing short of open seduction would prevent them from leaving the aisle clear for my frontal attack."

"Hm-m-m—so Pat Kennebec was Target for Tonight?"

"Do you dislike me for being honest?"

"Is that honesty a cover for deeper dis—"

"Pat, please. Don't say it."

"Then what shall I say?"

"Tell me—did you like it?"

Patricia looked up at Billy Thompson. "Now *I'm* asking. Can you take it?"

"I can take it," said Billy. "Tell me to go and jump in the lake, if

you want. I did what I did because—"

"Billy, it was rather nice."

"It—?"

"I liked it."

"Ah . . . er—"

"Billy?"

"Yes?"

"Best you can do?"

The silence was significant. Kennebec, eavesdropping, swallowed deeply, and left quietly.

"Billy?"

"Patricia?"

"You always call me by my full name?"

"I like to hear it."

"Billy, what do we do now?"

"We do nothing. As far as I'm concerned, Patricia, we've just met. From here on, we do all we can to know one another better."

"I—"

The beer and sandwiches were growing warm.

"—won't be able to know—"

And it was getting later.

"—if you keep my eyes closed all the time."

Billy took a deep breath. "The better to keep you from finding out all about me, my dear."

She held his face back between her hands. "Do you realize?" she asked. The head between her hands shook. "You have really known me for less than . . than six hours. And you're making protestations—"

"You forget," he reminded her carefully, "that I'd been contemplating Patricia Kennebec for a long time. There are some things

that are worth waiting for; things that require planning. I didn't know what the score would be at the end of this evening, Patricia, but I wanted so to find out. I've known you for a long time, Patricia. And, remember, little lady, that one need not fight bitterly for what he wants—sometimes it comes better if one bides his time and lets the fighters run themselves out of wind. From here, Patricia, let no man get in my way, lest he get his legs clipped out from under him."

"Supposing that I like him?" said Patricia.

"I'll only be fluffed off once," warned Billy. "There's one thing that I have that few other people have, Patricia. I can't really read minds, but I've discovered, ever since that little battle out there near Sscantoo, that I *feel*, and deeply, the truth of any man's feelings. But enough of that. We'll have time to quarrel later. Right now, Patricia—"

That night, the old adage died. The head that wore the crown of the Solar Combine slept like a kitten. And the only thing that bothered Co-ordinator Kennebec was that usual irrelevant wonder that crops up in the most trying of circumstances, though this was not trying, as circumstances go. Yet, Kennebec thought, it was like an hysteria almost; the unfunny joke that sends chief mourners off into gales of laughter. Incongruous and irrelevant, immaterial and inconsequential.

But why in the name of Sol didn't they go into the living room, and do their necking on the love seat where it belonged instead of sitting on the cook's tall stool in the kitchen?

XIII.

The scene at the proving grounds was a bustle of activity. In the center of the area stood a huge machine with a paraboloid reflector, pointing skyward on gymbals. Supporting the projector was a girdered and trussed platform, with tractor beams on each corner, pointing down to the center of Terra. Vast was the machine; no telescope in the Solar Combine was half as solid as the trunnions and bars that rigidized the setting of the relatively small, ten-foot bowl of the projector.

A line of portable telephone poles, strung with portable wiring, led from the housing below the projector. Off across the proving ground they went to a master control office almost lost in the horizon and the haze.

But the projector would not be studied from the remote position. That was just a clearing house—a veritable telephone exchange—that fed terrestrial data from all of the research laboratories of Terra to the monster on the proving ground.

Inside the housing was Cliff Lane, directing the technical staff. There, too, was Linzete, the catman, brought back to Terra by Lane's doubly convincing mind. Linzete did not like primates; he

avoided them and went out of his way to keep a two-foot clear space between himself and the primates as he moved around in the crowded housing.

The Terrans, warned beforehand, did their best to honor his dislike of them. They respected his preference in contact, though they, at this point, tended to use his mind and his experience as something presented to them. For they—and he—knew that their mental ability exceeded his and he was there only because his experience had been greater than theirs.

Out on the trestles and the catwalks of the machine stood Stellor Downing, directing the final touches of the monstrous mechanical system.

The operator called to Lane: "The sounding-boat is over the Mindanao Deep, sir. Ready and waiting."

"How's the terrestrial laboratory at Washington?"

"Ready for an hour. And Cal Tech has been chewing their fingernails for two hours."

"Call Downing and ask him how long?"

"Calling Stellor Downing—"

"On the roger," answered Downing, grabbing a phone from its rack on a catwalk.

"How much more greasing are you going to give that mecanno set?" asked Cliff.

"Oh, any time you're ready, we are."

"I know but—"

"Until the bell rings, we'll sort of pick curls of dust out of the bearings, put a drop of oil here and there, and see that the stuff is shiny—and as slippery as the devil."

The operator plugged into a ringing line. "Lane," he called after listening, "the crew just dropped the drone."

"Get the detector gang and tell 'em."

The operator unplugged and shoved the plug into another jack. He spoke, and listened for several minutes.

"Detector gang has picked up the drone," he announced to Lane.

"Ring the warning bell!"

The clangor of the warning bell shattered the air. Over the *tactac* of machinery and the rumble of heavy generators, it fell on waiting ears, and from all parts of the great projector there was a general rush to hit solid ground. A huge ring of men formed a hundred yards from the machine, and Downing entered the housing.

"Can we see better in here or out there?" he asked.

"In here," said Cliff. "The drone won't be within a ten light-sec range when we hit it. The celestial globe, here, has been juggled up to show both drone and projector. It's rough, but the lack of definition won't bother us. We can understand what's happening—and if it happens as we expect, we'll see it go blooey and be able to reconstruct the event. Stick around."

Linzete came and stood beside

them. "I think the sawtooth is not of the proper shape," he suggested.

"Perhaps not," agreed Lane. "But to put any sharper break on it will require another high-power driver stage. I'm hoping it will be adequate."

"The recovery time may seem slow," added Downing. "But remember how much distance it controls."

Linzete nodded dubiously. He was not the type to argue. If these gadget-mad Terrans were going to ruin a second-rate ship on the first try, well, they'd find out soon enough. He hoped they had a stock of radio-controlled drones. They'd need them.

They had—and they probably would need them.

"On target!" came the cry.

Above, the platform swung around. The projector bobbled over in its gymbals and centered on something invisible in the blue sky. The tractor beams took hold invisibly and there was a grunting of the bearings as the whole mechanism anchored itself to the core of the planet.

Then the projector jumped perceptibly. It seemed to gather itself together and pounce. Then the system relaxed, apparently, for the tractor beams died and the bearings resumed their freedom.

Down in the housing, the celestial globe showed a small, outdated cruiser. Speed was apparently zero, for the globe and its detecting and scanning circuits was following it, mile for mile and second by second. A range and computed below the globe gave the data: Nine light-sec range, velocity sixty-six MPS.

The cruiser faltered in flight and the scanners almost passed ahead of it. It faltered momentarily —that was during the time that the projector seemed to gather its energy. As the pounce came, something inside of the cruiser exploded very slowly. It expanded the cruiser slightly here and there; a plate blew off; five or six of the greenhouses shattered in puffs of mild fire; and then the cruiser staggered and continued on at a lower velocity.

"Send out the word," called Lane. "General coverage. That was the first shock."

Laboratories marked the time all over Terra. It would take hours for the shock—if any—to reach the antipodes. What Lane was more interested in was the report from Cal Tech, only a few hundred miles away.

"Linzete, you were right," said Lane. "It'll take time, and we'll need it. But— Hey! Fellows! Get the high-power stage rigged and see what can be done about increasing the sharpness of the sawtooth generator."

The period of waiting was filled with activity. The reports started to come in:

"Cal Tech reports very mild shock."

"Washington indicated almost zero—just a trace."

"O. K., we can stand it," said

Lane. "How's the target?"

"Circling Terra. Radius seven light-sec. Velocity fifty-three MPS."

The projector was ready when the drone returned. Again the projector gathered itself together, and the pounce was quite visible. Beneath them, the ground shook violently, and the projector and its mighty platforms rattled in the bearings, held as they were by tractors to the core of Terra.

In the celestial sphere, the cruiser faltered again, and then exploded in a wild blast of sheer flame, white and violent. The radiating gases expanded, passed out of the scope of the scanner, and then the scanner fell away from the scene and roamed aimlessly across the sky, showing a mad whirling pattern of uninteresting stars.

"What happened?" asked Linzete.

"Main target blew up completely. Nothing massive to focus on, so the finders and scanners just roam at will. That's it, Stellor."

"Wait until we get the seismographic reports," cautioned the Martian. "Maybe we can blast a ship to bits at two million miles, but so what if California slides into the San Jacinto fault?"

"Well, there'll be no more attempts until the returns are all in from the labs," said Lane. "I'm taking no more chances." He turned to Linzete. "You'll want the plans, of course?"

The Sscantovian nodded. "I will not require the main circuits, of course. The snatcher portion is just an oversized version of our own invention. What I shall need is the details of the compressing sphere. We were content to tear a section out of the ship. You made a precision slicing operation out of it which pleased us greatly. But this problem of taking the spherical cut and actually compressing the matter inside—then releasing it instantly to create an atomic explosion is far beyond me. We can copy it, but no Sscantovian would ever hope to develop it from the facts here unless he had detailed plans. We—could not understand its operation."

"You did understand the main principle, though. You were the one who predicted that the release-time was not fast enough and suggested sharpening the sawtooth generator."

"One may make suggestions without understanding the whole process," purred Linzete. "Your weapon seems to be a success."

"We'll know that when the seismographic reports are all in. Hurling a beam of this kind, doing what we do, may well shake the planet's crust. We hope to extend our range to ten million miles, and we'll know if we can in a few months. If you have any deities, Linzete, you might burn a prayer to 'em."

It was thirty-six hours before the returns were all in. All along the fault-lines of Terra came reports of very mild temblors. Nowhere was there any severe slippage of Terra's crust; the seismo-

graphs could find no epicenters, the uncounted tons of rock, under unknown tons of pressure, had slid uniformly, creating a general, little shock.

And Lane grinned. "With little slippages," he said, "we may do away with all severe earthquakes. Releasing the crust-pressures before they build up to a disaster-quantity should help, not hinder. We might continue hitting small targets like this until the distribution of fault-pressures is even all over. Then we can swing the Big Beam."

"What I'm interested in at this point," said Downing, "is the countermeasures group. What if the Loard-vogh get this thing?"

"Billy says that they can't miss getting eventually. And Billy also says that the countermeasures gang is working on another development. Has something to do with a similar gadget, only the sphere of force can be made to pierce the snatcher —or any other field of force—and remove smaller items inside. Sort of grab the stuff out from the contracting sphere and toss it outside. It might save a lot of the crew, especially since the atomic sphere is necessarily small."

Linzete purred and asked: "Couldn't you compress a whole section of the ship?"

Lane turned. "Billy says we could, but why? Takes that much more power, and the ultimate explosion would do little harm. This way we can grab a hunk the size of a baseball and make quite an atomic blowup out of it. Takes much less power, and the explosion is great."

"I think you'll find," offered Downing, "that it takes just as much power to wreck a ship by crushing it physically as it does to compress a small sphere and then let it explode."

"The atomic explosion takes more," said Lane.

"Then why?"

"Projector-size. We're getting away with swinging a ten-foot bowl around. If we wanted to inclose a whole ship, we'd require a paraboloid about forty times the longest diameter of the ship, just as the ten-foot bowl is forty times the diameter of the compressible sphere. And cutting a section out —well, that's the weapon we had before and decided against because it left a chance for a well-designed ship to lose a section and still carry on, or be repaired. Complete destruction is the only answer."

"In other words, the power input is greater, but the operational power—?"

"The overall power requirements of the atomic sphere projector are about even this way to just crumpling a ship."

"That's what I said," objected Downing.

"I thought you meant just the crushing factor. The difference is made up in the projector elements. Well, that's those. Billy says we can turn this over to the secondary crew, now."

"Then what?"

"I'm going to get six of these made up for each planet. We'll

also mount some on the outer planets; and the colonials of Alpha, Procyon, and the rest."

Hotang Lu pounded the table with his little fist. "That weapon might have stopped them!" he snapped. "Why did you stop production?"

"Are you questioning my motives?" asked Thompson quietly.

"Yes!"

"Have you any doubts as to my loyalty?"

"I . . . ah . . . no."

"And you do not understand my intent?"

"No."

"He's not alone, Billy," put in Kennebec. "What do you intend to do?"

"The use of Terra's secret weapon is critical. It must be employed at exactly the opportune moment, and not one minute before and not one minute after. There must be, for psychological reasons you all know, a certain amount of normal, mine-run fighting before we employ our secret. But I do not want them to be defeated by our might and our weapons. That would be disastrous, for they would return in a few years, and they would return and return, until finally they succeeded in conquering us. We must fight this as I have planned, and when the time is exactly ripe, we shall employ our secret weapon and from that time on, there will be no more carnage, and the Loard-vogh will be conquered."

"When you're dealing with the Loard-vogh, there's no better way to skin a cat than to grab the skin at the neck and pull," scowled Downing. "Choking them to death with cream will not work. I spent three weeks there, remember, and I tell you, Billy, you can not temporize with them!"

Kennebec shook his head at Billy. "I wonder if your practice of getting what you want without fighting for it mightn't be carried too far."

"We are a million million in population," said Billy. "That's counting the Solar Combine plus the colonial outposts. This fight we're facing can not be won in another way. They outnumber us a million to one—think of that! To win, every Solarian must kill one million Loard-vogh! And that," he concluded bitterly, "makes us all come out even!"

"There isn't a man in this sector that wouldn't prefer to die protecting his own than to knuckle under Loard-vogh rule."

"I know—"

"Billy, I can not permit this order to continue," said Kennebec. "We must not permit them to take Terra!"

"Then you're overriding my order?"

"I am—and I pray that the procrastination isn't fatal."

Downing frowned. "Look, Billy, remember this: The Loard-vogh fear us as we are! Otherwise they would not be mobilizing against us. Despite the million-to-one ratio, they fear us and our heredity. We can and will win!"

"We'll win, never fear," said Billy. "But we'll win only if we play it properly."

"And properly means to fight with every weapon that we have."

"Spore bombs?"

"That's but one thing."

"They'll help—only to make the other trillion Loard-vogh mad. Douse a few planets and thousands of others will muster."

Billy Thompson thought for a moment and then answered: "Really, it makes little difference how we fight. We'll win anyway. Go ahead and build your gadgets."

He left, and Hotang Lu nodded. "I pray there is time left. Time to build smaller ones, too, that will fit the ships of the Solar Guard. Time to manufacture the necessary fighting equipment. Time to . . . ah, always we are fighting time. I curse the lack of time."

And then the Tlemban added: "I am mystified. In my cosmos, if a secret weapon is worthy of use, it is worthy of use from the time it is discovered. I am puzzled—but then, I do not understand your secret weapon. It sounds foolish to me."

Kennebec spent the next three hours trying to make the Tlemban understand, and finally gave up.

XIV.

Lindoo strode into the presence of Vorgan, Lord of All, and handed an aide a scroll for the record. The Lord of All nodded and said nothing. Nor was there anything to say that had not been said previously. Any further discussion would be merely re-contemplation of ideas. The proof was four months off.

It would take four long months between this day—when Lindoo handed Vorgan's aide the scroll, giving the official date and time of I-second, when the invasion spearhead of the Loard-vogh blasted upward from the locus and headed for Sol—to the time when the first of the advance flight reached the Solar Sector.

Four months of just sheer waiting. Four months which the gadget-mad Terrans would use in preparation after the grand fleet of the Loard-vogh was a-space, and growing flight-weary.

Four months, full of intership bickerings and man-to-man fights because the quarters were too confined.

For the Loard-vogh were a quarrelsome race, and their fighting men trained to viciousness. It is not strange that with four months, cooped up in shells of steel, they should take to fighting among themselves. It was strictly against the regulations, of course, because the Lord of All wanted his fighting men to kill the enemy. Yet a fighting man will fight if he has nothing else to do, and for four long months there would be absolutely nothing to do. The Loard-vogh fighting man knew little else but battle. Trained from youth to be hard, vicious, and ruthless, he knew nothing of the art of killing time. Confinement made him more vicious when released, and the

officers overlooked a given percentage of fights among the men. It was better that the ultimate viciousness be great than to have their men soft with other arts.

A goodly supply of other arts among the Loard-vogh would cause less casualties. Had they been mentally and physically trained to carve ivory, play chess, tie knots, or build spacecraft in bottles, their lives would have been less violent, including the madness with which they drove forward their attack.

Forward went the grand fleet. in the lead were the fleet fighter ships, and following them were the second wave craft. Third came the heavy supercraft, the backbone of the grand fleet of the Loard-vogh. A day behind came the mop-up transports, crammed to the space cocks with fighting men, their nerves already on edge after a short day or two of flight.

And bringing up the rear were the myriad upon myriad of supply ships, replacement carriers, machine-shop craft, and even space-going foundries. Heavy ships laden with munitions and generating equipment; craft that could anchor to the sunward side of an inner planet and hurl megawatt after megawatt of power to the fighting ships for their power-coffers. Huge—frameworks—with the equipment exposed to space. Planet docks for the repair of ships damaged in fight.

Forward drove this horde; forward into the Solar Sector. An all-conquering mass.

Silently and invisibly they sped in a long, cylindrical space pattern.

Object, Terra.

Not unmindful of danger, Sol was working furiously. Factories, their dies rusting the yard, were turning out parts for the atomic sphere. Dymodines fairly rattled off of production lines and were installed in the minor ships. Modines, the personal side-arm miniature of the dymodine, came with a rush down the production line conveyors and slid into wrapping machines; were wrapped against all destructive, natural forces and then were packed in boxes for shipment.

Planet-mounted snatchers came to location by skytrain in parts and were assembled on the spot by skilled technicians.

The vast machines that generated the atomic sphere were being assembled and shipped to the several places. Here they went together, fitted bit by bit by machinists and technical men who worked furiously against time to complete the job before the Loard-vogh came.

They were many years building the original Palomar telescope, but this was war, and the techniques of fabrication had advanced since then. Perhaps the experience gained in that monstrous job—and in other mighty projects, some war-driven, some peace-measures—gave Sol the technical skill she needed. There would be no matter of years, this time. It was a matter of four very short months.

One hundred and twenty days.

Just one small third of a year. And there is a saturation point in the manpower curve; just because one man can dig a well in sixty days, it is no sign that sixty men can dig the well in one day. They could, mathematically, but you can't get sixty men with shovels in a three-foot circle either mathematically or physically.

So time bore on relentlessly. Time that for the Loard-vogh seemed endlessly droning by was racing like fury for the laboring Terrans.

For at the same instant that Vorgan was groaning about the four-month wait, Thompson was complaining about the utter impossibility of getting anything done in four months.

What hurt Vorgan's sleep most of all was the fact that he feared that Terra knew of the imminent invasion.

Terra knew, and that spoiled their sleep, too.

But they did not tell Vorgan that they knew. If the Lord of All had known for certain, he would have slept better, for the uncertainty would have been removed.

For four long months, Vorgan's vicious crew of Loard-vogh warriors drove through space, and then they deployed in battle array. Their nerves tautened, and the personal fighting ceased, for the chances of battle with a legal enemy stayed their hands against their fellows.

They knew that they were approaching enemy territory. Their first glimpse of trouble would be a mushrooming blast in the sky—or even several simultaneous explosions.

The first that went up would be a deadly signal that near by, or dead ahead, their hated enemy was making his advance stand. That was the gamble. They each pinned their hopes on being the watcher. Let another ship go up in fire and flame. In this game, where no man could help another, none even considered the idea of wanting death in preference to another. For one man's life was exactly as good as any other man's at this point —for until the initial shock wave hit, neither was doing a thing.

They were on the offensive, the Loard-vogh. They were breaching a system that their leaders feared enough to break the Master Plan and send forth a full grand fleet to take this sector that lay more than a thousand light-years from the frontier of Loard-vogh conquest.

As the Loard-vogh was on the offensive, the first move had been taken—by them. The next move was up to Sol. And that retaliation would take place soon was not doubted by any man.

Fifty light-years from Sol they slowed and alerted. They wondered, those leaders of that invasion, when the blow would fall. Was it wiser to wait until the enemy was alert? To wait until the enemy was waiting for the first detector alarm seemed brash. The Loard-vogh method was to strike like a hidden snake, and beat the enemy

to the ground before he knew what was waiting for him.

It made them nervous.

And a psychologist who had studied both the Loard-vogh and the Terran minds from a dispassionate standpoint made the observation that the Loard-vogh might have been better equipped to cope with a slashing surprise attack, but were completely baffled by the obvious foolishness of waiting.

Three days Terran went by, and the secondary waves of Loard-vogh came up, adding to the general confusion. Orders rang through space and the following waves of the grand fleet slowed so that utter confusion would not hamper their action.

Then, eight days after the first arrivals, and still with no attack, the Loard-vogh decided to move in another ten light-years. A star twinkled there. It had been this stellar outpost that the Loard-vogh feared. Their methods of defense would have been to arm every planet of this star with energy enough to reach three light-years into space and crush any oncomer. They were wise. They gave a three-times plus safety factor just because their Lord of All was afraid of Terra.

And they admitted that they, too, feared Terra.

With slow care, the spearhead moved forward. The grand fleet moved in waves once again. Slow, overcautious waves, and they worried all the way. They knew. They knew that it would come any minute now.

But nothing came at five light-years from the star. And at three light-years there was not a sign in their detector systems. A single light-year gave them the same indication, and they swarmed about the star—now a blazing sun, and searched the heavens about them for the sign of enemy activity. They gave the seven planets a wide berth, and would stay away until they were very certain—

So this was the feared and hated Solar Sector? Not even an outpost. Not a scout. Not a sign of activity!

The Loard-vogh took a deep breath and sighed in relief. And while they were letting their breath out, Sol struck—and hard!

XV.

In the long-range scanner, the Loard-vogh fleet were but shapeless blobs. In the past hours, they had become detectable, and now were spreading out as the terrific velocity of the Terran fleet dropped down upon them.

"Now?" asked Downing.

"Better wait another minute," suggested Cliff.

"O. K. The judgment of when is best is tough, sometimes."

"Better we should blitz eight or nine of them for sure than to try and get fifteen but miss all but six. And don't forget that we're in the lead. The boys in back will have more time to spread out and get the outlying ships."

"I'd like to stay running free as long as I can," said Stellor.

"It makes us just that harder to detect when we are not radiating," agreed Lane. "Too bad we can't run right on through this way."

"Yeah, but we've got to use echo-ranging for the ordnance directors. We can't just use their radiation as a means. And if we use echo-ranging, that means squirting out the prime signal. That means detection anyway, and we might as well use power, too."

"What's our speed?"

"Point seven nine light."

"Fast enough," grunted Downing. "O. K., let 'em have it!"

At seventy-nine percent of the speed of light, the free-running ships came to life. The drivers went to work at the same time that the first pulse from the ordnance directors went out. The turrets, already trained by hand, moved only seconds of arc to correct for speed, when the pulse-echo returned with the data. And with the return of the second echo, reducing the error, the projectors belched energy.

In the Loard-vogh, detectors screamed and flared. Turrets, directed at random or stowed for travel, whipped around, the projectors rising in elevation. Defensive equipment went to work—but not soon enough.

For a dymodine crossing a dymodine will stop both, but they must be operating simultaneously. The Terran ships fired first, and they hit.

The sky had been serene. There was the star, blazing as a sun should blaze, the only thing in view against a stellar curtain. The ships of both

fleets were black, and minutely invisible against the sky. The planets of this star were as much a part of the stellar backdrop as any planets are, even on Earth, and the appearance was just that of a very distant disk, half-dollar size, blinding white, poised against a vast, never ending wall of twinkling points.

Thirty seconds later, man had

passed through—and left his mark.

Dymodines flashed incandescent spots that erupted in flaming gases. Snatchers sliced backbone from the ships of the Loard-vogh and they crumpled; some exploding. Three atomic sphere projectors found their mark and three of the Loard-vogh blasted themselves to bits, leaving only expanding masses and hard radiation—against the sky were moving flecks of death; the Universe was spreckled with novae that spread as they were watched.

Death, silent and unspectacular from a distance, struck.

And the Terran ships were through the Loard-vogh fleet and gone.

But not unscathed. Trailing lines of whispy, incandescent vapor from their intrinsic velocity, nine Terran ships traced their lives across the sky.

"Made it! Call base and tell 'em," said Downing.

The connection was already established. "Thompson? We got twenty-two. Thirteen definites and nine more-than-probables. Seven with light damage. Lost nine."

"Good, Stellor. Now don't try it again. They're wise and they'll clean you out."

"I'd like to take my chance on one more run."

"Don't do it. You'll be cleaned."

"But they'll make a base here."

"They'll make it anyway. How's their numbers?"

"Terrific. They've got everything."

Thompson grunted. "I'm not surprised. After all, they have a quarter of the Galaxy full of them, and even though slave labor isn't the best, a planet full of slaves is better than half a planet of free men if you accept that a slave is fifty percent efficient."

"I'm beginning to see futility ahead," said Lane.

"Well, don't. Terra has a secret weapon that will win for us, you know."

"I know, but you can't swing it yet. It's the waiting and the back-breaking fight that must come first."

"Too bad we can't just let 'em roar in close enough to use it all at once."

"Wouldn't work. We've got to wait until the psychological moment. Then—we'll swing it."

"O. K., now what?"

"Don't toss away any more ships. Not right now. Let the Loard-vogh establish their base," explained Billy. "We can't stop 'em anyway. Let them come on in. I want them close enough so we can get at them without having to go all the way out to get them." He thought a moment. "Tell your boys not to use the atomic sphere any more than necessary. You know why."

"We got a few with it."

"All right," answered Thompson. "At that time it was expedient. We had to dent them to make them cautious."

Lane said: "I don't see why we just don't let 'em roar on in close and then use Plan One on them."

"Wouldn't work that way. They are too numerous. Before Plan

One is efficient, we must give them a tough fight. Otherwise they will not understand that we mean business. We'll win only after we convince the Loard-vogh that we are worthy opponents in their own type of fighting. Otherwise they will wipe us out by sheer weight of numbers despite Plan One."

"I know," grumbled Lane. "We've been through all that."

"Well, then you know that Plan One will work only after a certain number of them have reason to fear our arms."

"O. K., Billy, we're coming in."

"No—not yet. Head in for Procyon IV and wait for them there. Give them as good a fight as you can."

Inward swept the grand fleet of the Loard-vogh. The other six planets of Procyon were pushovers; the Loard-vogh hit the planetary defenses, knocked them down by outnumbering them, and landed. The colonial population headed for the hills and hid out. And as the mop-up squads beat the bush, many of them did not come back. Yet it was futility, for Vorgan's vicious minions held the planets eventually.

But on Procyon IV, they had trouble.

The fleet came down in a multiple line and encircled IV. Terran forces fought back.

Up-shooting beams crossed with the Loard-vogh weapons and made the air a seething hell. Snatchers ripped the bellies out of ships, and from the ships there came answering snatchers that gouged spheroidal chunks out of the planet along with the projector crews and hurled them aside.

Nuisance weapons—air torpedoes and space mines—floated freely and exploded, filling the air with flying slabs of metal.

And then forty of the finest made a landing. They forced their way to the defended surface, scoured the ground beneath them with a solid curtain of energy, and scarred the countryside until nothing was left to stop them. They landed, set up a vast circle, and into the center of the circle there poured a constant stream of Loard-vogh transports.

"All right!" barked Lane. "Get the heavies over!"

"Heavies on the way!"

"And bring up the atomic spheres."

Twenty of the atomic sphere projectors came zooming over, suspended on tractors. They dropped on the circle and the tractors anchored them to the solid core of IV.

The paraboloids swung over and gouged pieces out of the center of the Loard-vogh camp and let them blast loose with their atomic fire. The Loard-vogh died like flies under the terrible energy—and like flies they came on, replacing those gone.

The air above the camp was seething. The ground below bubbled molten in spots. The periphery was a raving, solid mass of sheer energy. The bubble between the Loard-vogh forces and the Terrans

was shimmering energy that pulsated in and out like the beating of an irregular heart.

And in spite of the utter madness of trying to enter that holocaust, the Loard-vogh poured in. One man made the safety of the inner shields to every hundred that came, and that one in a hundred multiplied, added to those already there, until the shell of murderous energy.. swelled of its own incompressible contents of Loard-vogh material and men.

The shell expanded, moved outward against the fire. The atomic spheres moved backwards, and as they moved they were silent. The Loard-vogh took advantage of the silence to shove farther. A salient fingered out—

"Cut it!" snapped Downing.

"With what?" asked Hayes, the commander.

"Drive in there—they're cutting off projector seven."

The salient swept out, forcing Terran arms back. It curved around, swept back, and had Number Seven within the loop. The pocket closed and the bitterly contested area was a wide bulge on the edge of a circle.

Another landing took place.

And another, not more than a mile away.

And then across the plains of Planet IV, of Procyon, there rolled endless, countless mile after mile of ground equipment. The heavy portables started to hurl their might as soon as they came in sight, and the Terrans were pinched.

Pinched between an embattled circle and a closing circle. The inner circle expanded, the outer circle contracted.

Downing's ship roared into the concentric fire, its turrets whipping back and forth and spitting sheer energy. Behind him there sped the twenty-four ships of his command. Into the holocaust they drove, piercing the Loard-vogh line momentarily. The hole widened briefly, and then closed down behind them. Englobed, the flight pressed close together and fought outward.

It was stalemate—and yet nine of them dropped as inert, flaming masses.

"Enough!" called Stellor. "Back!"

And his flight formed, was forced apart, and reformed. They drove for the inside again and ran up against a solid wall of ships.

Downing's flight dwindled. Pressing close, the Loard-vogh fired their torrents of energy into Downing's ships at projector-burst range. One by one the ships flamed and went down in a smoke-trailing comet.

"Help?" snapped Lane over the sub-communicator.

"Stay out—" started Downing. He was cut off as his command burst into flaming, violent death.

Thompson's voice came over the interstellar band. "Better retreat now," he said.

Lane answered. Here in the scanning-ship, the torrent of energy and deafening sound was gone, and only peaceful quiet reigned. Save

for the constantly swirling fire in the battle plotter globes and the everlasting flicker of pilot lights, there was no evidence of the swift, concentrated hell that went on in the space between spheres that approached one another.

"Downing tried it," he said.

"Get many?"

"Swapped his entire twenty-five for forty-one of the Loard-vogh before they got him."

"Not at all bad," answered Thompson.

"I'd like to try it—?"

"Nope. Better collect Downing and the rest and haul tail for Terra. We're about due for the big show."

"Downing is—"

"Back," answered Stellor, opening the door. "I'm sorry to be late, fellas. They asked me about the fight out there in the hall and I stopped to chat. I didn't know you were on the line, Billy."

"Well, how was the fight?"

"Fierce. I'd hate to get into one like that, for real. Billy, will the personnel snatcher save enough of our men to lick them?"

"Saving every man aboard a doomed ship at the moment of destruction with the individual snatcher globes is a good way of not losing a man," explained Billy. "But it doesn't save materiel. They've got both, in plenty. We'll have to fall back on the secret."

"But when?" asked Lane.

"When the time is ripe. And not one moment before."

Thompson rang off. And then with a concentrated effort, the Solarian forces drove upward in a piercing needle of ships. They broke through, not without loss, and made their escape into the sky. When they landed on Terra, every ship was crammed to discomfort with men from stricken ships—literally snatched from the jaws of death with the personnel snatcher.

In numbers enough to take a whole planet, the Loard-vogh landed on Umbriel and overran it in an hour. Inward they swept to Titan and the Saturnian colonies. Inward they came to overrun Callisto and Ganymede.

Downward they dropped to Phobos and Deimos, where they set up vast projectors and hurled the attack upon Mars. Simultaneously they fell upon Venus—a monstrous horde of ships. Systematically they went through the Evening Star taking area after area, and they held Mars in their grip at the same time that Venus fell to their hordes.

"God—their numbers," groaned Cliff Lane. "I'd hoped that they might find it tough to hold everything and still hurl fresh equipment into Sol."

"They are numberless," said Hotang Lu.

The Loard-vogh swept into Terra.

Terra, the home of man. Terra, the mighty. Terra, defended as few planets were defended against the legions of Vorgan, Lord of All.

Despite the humans on Venus and Mars, they were still colonies compared to the home planet. Knowing that massed energy might hold out, all Solar defenses had been moved to Terra. Let Terra hold

out and eventually mankind would recover, expand, and then drive the enemy back.

And when the Loard-vogh came to Terra, they found it defended against them.

Nowhere on Terra was there a place to land in safety. They took dead Luna easily and hurried to set up a long-range beam. Atomic spheres of unheard-of size reached upward from Terra and Luna sparkled with mighty atomic storms. Whole detachments of the Loard-vogh flamed into incandescence as the super-atomics bit fifty-foot spheres out of the face of Luna, compressed the matter itself, and let it explode.

They made a landing in Siberia and the encampment burst with a roar that shook the earth.

Overhead they roared, raining down energy that never reached through the upthrust beams. The cities were fortresses that hurled power into the sky, and though the shattered wrecks of the Loard-vogh dropped like rain, none of them reached Earth in large enough pieces to do any damage. The air took on a metallic smell, and ozone fixed out as the stratosphere shimmered in the grip of a torrent of energy beams that crossed and nullified one another.

Across the face of Terra, the high-power transmission beams hurled energy back and forth. Energy to feed the projectors that fenced with the ships of the Loard-vogh. Beams that ran on sublevel energy and could not be cut.

In the master room, there was a huge globe, wired with multicolored lights. And as the battle swept back and forth over the face of Terra, the lights changed from dark red to violet, depending upon the power drain of that district. Master technicians, making lightning calculations in a mathematical medium adapted for power work, viewed the globe and pressed buttons that hurled relay-impulses across Terra to switch and divert power for the needy locations. Their hope was to maintain a medium red all over instead of bright violet here and almost-black red there.

The Mongolian sector flamed violet after the Siberian attempt was made. Power was switched from Africa, raising the dark continent higher into the red and lowering the dangerous violet of the Mongolian sector. A sortie hit Africa, and the area pulsed briefly into the yellow and died before the technician could hit his button.

North America caught it next, and power came from Antarctica to drive the invaders away. The Mongolian effort stopped and the map died into black. The extra power went into North America and it became a less dangerous color.

And then the Panamanian district flared up. Into the violet it went, and the switches flew to drive power into the isthmus. Spreckled all over the globe were minor flarings, and they all increased as the Panama Zone took more and more power and still crept upward and upward.

It was all very much like a game

of chess here in Terra's Master Power Distribution Center. But on Panama, another scene was taking place.

Four thousand of the Loard-vogh dropped to ground, driven by sheer power and as they landed, they anchored themselves to the crust of Terra.

A super-atomic reached over and its sphere of energy clutched—another atomic sphere.

Their inflexible beams strained against one another. Wrestling in subelectronic space, pulling and straining against one another. The crust of Terra groaned and the fault-lines rubbed and heaved. The inflexible beams pulled, trying to uproot the other—and both were anchored to the crust of the planet.

Luckily, the beams broke before the very surface of Terra gave. The backlash shook Terra to the core and the tidal waves lashed out against the shorelines. The ground shook, and the resulting quakes did what the Loard-vogh had not been able to do. The quakes shook earthly damage into the cities of Terra.

The energy continued to pour into the Loard-vogh planethead. The air shimmered and burst away from the hemisphere of terror, and the resulting convections drew fresh air in to be heated to almost-incandescence and driven upward.

Hotang Lu faced Billy Thompson bitterly. "This secret weapon of yours," he demanded, "it was to win for us?"

"It is," said Billy.

"IS? Is it not time that it be used? The Loard-vogh are upon the planet itself. Death looks us in the face."

"It is not yet time."

"Once before you were under their control," said Hotang Lu sharply. "Your actions now—and for the past weeks of terror—lead me to believe you are again."

"I am not."

"And who can prove it?" argued Hotang Lu.

Kennebec shook his head. "He is the one who might prove it—if you cannot trust him, who can be trusted?"

"For this, Toralen Ki died," said Hotang Lu bitterly. "My friend—dead! He died in the hope that this very thing would not happen. He met death quickly, even argued with you for the chance. A friend walked into the valley of the shadow for Terra, and Terra sits by and spits on his life by doing nothing. I would—"

"Stop it," snarled Billy Thompson. "You and your ideas. You simple fools. To think that you believed that one small system could come up ten thousand years of evolution in a year and beat a quarter of the Galaxy! I'm fighting your battle, and yet I curse you all! Have you ever stopped to think that if it were not for you and Toralen Ki, *we would not be in this killing battle?* To die for an ideal is all right. Toralen Ki died happy, at least! He believed that he had done his part, and no more could he do. Fine! The Loard-vogh would have ignored us for another three thou-

sand years if you had not come here and stirred us up. Now we reap the seed of your foolishness.

"Terra writhes under the energies poured out by more ships than we have men! Gone and lost are our hopes, and our peaceful future. Our secret weapon? Our secret weapon will be successful—and from then on Terra must ever be alert and on guard. Think you the Loard-vogh will bow to us? Our secret weapon must be used from now on, every day, every minute of every day from the time we unleash it to the end of eternity.

"And if you hadn't stirred us to it, peace would reign on Terra for another three thousand years."

Hotang Lu stepped back a pace, but faced the angry Terran firmly. "And your children's children, three thousand years removed would have this fight to make."

"So what? Does that bother me? Can I grow anxious over the certain knowledge that the Universe may end ten to fifty years from now? Who can predict? Perhaps three thousand years more of evolution and science would bring forth a weapon far superior to their best. And if we remained in mental ignorance, well—is the worm unhappy? Does the beetle miss the trappings of civilization? Does the ant know of Earth moving machinery? Does the bee employ electricity?

"So we fight another race's lost battle for them, brought about by them, hurled upon our shoulders by them, and you, their representative, question my motives. The secret weapon will be unleashed in time."

"Be careful lest you cut the line too fine," warned Hotang Lu. "You are my mental superior in capability, but not in training."

"Showing the fallacy of your actions," snapped Thompson. "Had you been wiser, you would have known that the untrained ability to be a genius is less important than a normal man working at high intensity. Question your own judgment, Hotang Lu. And worry—in retrospect!"

XVI.

The Loard-vogh expanded their sphere. And like the attack upon Procyon IV, another globe of Loard-vogh d r o p p e d upon the planet. The power distribution center fought against itself and sapped power dangerously to drive off this new invasion.

A third invasion turned the trick. Power distribution failed; fell apart despite attempts to hold the network together.

"Your secret!" screamed Hotang Lu to Thompson.

Billy shook his head. "It is not yet time."

The Tlemban appealed to Kennebec.

The Co-ordinator of the Solar Combine agreed with Billy. "You still do not understand," he told Hotang Lu.

He faced Lane and Downing. "They will conquer us!"

Lane spoke for the pair of them. "You needn't appeal to us. I had partial foresight before—you said so. He had the ability to make

lightning plans." He turned to Downing. "Or was it the other way around?"

"No matter," answered Stellor Downing. "Foresight is no good when planning is a part of the psyche. Instinctive and impetuous action do not match well with a planning nature. Since the transformation, we have both been slower—and quite bewildered, most of the time. No, Hotang Lu, all you can get from us is resentment over losing our ability to lead. Now, we no longer decide anything for ourselves. We cannot make up our minds."

Hotang Lu went to Patricia. "And you?"

"I am not a ruling voice."

"Prevail upon them."

"It is not my place. Besides, you do not understand."

"I understand this!" exploded Hotang Lu. "You are invaded. You will be conquered. You will join the slaves of the Loard-vogh. They will strip you from your homes and make you work for them. You will be driven and killed, for they have no compassion. They have no need of frugality in slaves. Terra will die."

"It is not yet time."

"Your judgment is faulty!" shouted Hotang Lu.

He hurled himself from the house and into his tiny spacecraft. He paused for only an instant to view the grave of Toralen Ki on the broad green lawn, and then he drove upward in superdrive. His size and his speed got him through, and Hotang Lu headed for Tlembo—alone and a beaten man.

Lindoo picked up the communicator and spoke to the operator. The connection beamed across the light-years and found Vorgan.

"Lord of All, it is going well."

"Give me the details. I was afraid of their secret weapon."

"Lord of All, the phrase 'secret weapon' is an old Solarian trick. It is meaningless."

"Go on."

"We landed on the isthmus that connects the two areas of land on the Second Hemisphere of Terra. The going was very hard, Vorgan. They drew power out of their sun like a torrent and we caught it all. It was terrible, and it was glorious. Our brave men died like flies—and not even the rock itself could stand against the energy turned loose. But we outnumbered them. We invaded again and again, and divided their power. Now we are screening the sun to run down their power intake. The globe expands, and we are holding most of the southern Land Area. From the northern pole, an invasion circle is spreading to meet the one on the isthmus."

"The other planets?"

"All taken."

"Terra is about through," breathed Vorgan.

"They are."

"I was deeply afraid," admitted Vorgan. "They are a vicious threat."

"Once conquered, though, they will be most useful."

"Yes, indeed. A race with the

will to live is far superior to a race with a will like a bunch of cattle. They will rise high."

"Vorgan, you may have my throat for this, but I feel that it is a shame that we could not have them as equals."

"That would never work."

"I know it wouldn't. But it is a shame. I feared the landing here, Vorgan. The place is rife with spores, fungi, and bacterial death. But their weapons scoured the area."

"The fools."

"I know—but we are safe now. Terra is conquered."

"Then as soon as possible, bring me the ones I want."

"Lord of All, you will have them."

The air above Terra grew less turbulent, the energy died. Loard-vogh ships found less opposition as they landed at will on the former Planet of Terror. By hundreds and by thousands they landed—and by thousands they died as they tried to flip back their helmets and breathe the air of Terra. They turned black, they fell down, and the growths of ravaging microscopic life raced and built into horrid green mold and whispy hair as the growths of fungus found absolutely no opposition.

But with better direction, the Loard-vogh roamed the planet without death, though fungus-spores drifted freely. Their suits grew cultures, and the lubricants teemed with growing life—and if the inhabitant stayed too long in the suit, he died as fungi grew in the lubricant and was carried inside of the suit by mere action.

Air-tight to seventy pounds they were, those spacesuits. Seventy pounds inside or outside—and yet the insidious growths slipped inside and killed them.

But their numbers! As they died, so they were replaced. And the roadways thundered to the treads of their portables; the sky roared with the passing of their planes; and the cities echoed and re-echoed to the tramp of their feet. The sky was dark with their light spacers, landing, and the air was roiled mechanically with the landing craft that dropped from the spacecraft in never ending streams.

Lindoo, arrayed as a conquering hero of the Loard-vogh should, awaited in the grand spacecraft of the Loard-vogh at Panama. The area had been scourged by fire and by sheer energy. Yet the tropical climate seemed to spawn trouble for the Loard-vogh.

Behind a triple sheet of reflectionless glass, Lindoo sat, outwardly triumphant, but inwardly afraid. He hoped that the powerful, colorless antiseptic mixtures between the sheets of glass would keep him safe.

Hurled in to the other side of the room were Kennebec and his daughter. Thompson followed, and Lane and Downing were hurled in lastly. They stood up defiantly.

Kennebec faced Lindoo. "You are the emissary of the Loard-vogh?"

"You know me—and my language?"

"Why not?" asked Kennebec. "Your speech is not difficult."

"No matter. You have this ability with all alien tongues?"

Downing smiled. "I spent one month among your planets, mingling with your people. They did not suspect."

"All alien tongues?" insisted Lindoo.

"Any, and all, can be learned by us in a matter of hours."

"Your race will be useful. Do you now accept defeat?"

"It was forced upon us?"

"Accept it!" exploded Lindoo, "or die!"

"A dead slave is useless," reminded Kennebec.

"And a dead malcontent is no trouble," snapped Lindoo. "Do you accept defeat?"

"As I said, defeat was forced upon us. Yes, we must accept defeat."

"Then broadcast the order to cease firing. Order Terra to drop its arms and submit."

"Will the integrity of our people be preserved?"

"Unconditional surrender does not permit terms."

"I will surrender unconditionally —but I demand the right to be treated as a worthy opponent."

"Your defeat at our hands was inevitable."

"We know that."

"Then why did you fight?"

"Only to gain your respect as an enemy."

Lindoo bowed his head briefly. "You have our respect. You have had our respect enough to cause a major change in the Master Plan. You will not be treated with contempt. There will be no looting, no pillage. Not if you will submit without further fight."

"Your terms I accept."

And Kennebec picked up the communicator and snapped the switch to General Broadcast.

And on Procyon IV, four survivors clustered around a crude, haywired receiver picked up the message. When it was through, they left their hidden cave full of Loard-vogh souvenirs. Openly they walked to the nearest encampment and knocked on the stockade.

And across the Galaxy to Vorgan, Lord of All, went the final word:

"The Solarian Sector is complete. All Solarians are being tested for adaptability, and upon completion will be trans-shipped to the proper situations in the Loard-vogh empire. Terra, Sol, and the entire Mutation Area will be left devoid of life."

Within hours, Lindoo was working on the problem of displacement. He—and all of the Loard-vogh—worked madly to complete this project. For all of them wanted to leave, forever, the former Planet of Terror.

Terra—conquered, completely!

TO BE CONCLUDED.

by
ARTHUR
C.
CLARKE

Loophole

The Martians knew when Man developed the atomic bomb—and they knew Man's warring character. So they took steps to see that Man stayed on his own home planet. That was a serious error—

Illustrated by Williams

From: President
To: Secretary, Council of Scientists.

I have been informed that the inhabitants of Earth have succeeded in releasing atomic energy and have been making experiments with rocket propulsion. This is most serious. Let me have a full report immediately. And make it *brief* this time.

K.K. IV.

From: Secretary, Council of Scientists.
To: President.

The facts are as follows. Some months ago our instruments detected intense neutron emission from Earth, but an analysis of radio programs gave no explanation at the time. Three days ago a second emission occurred and soon afterwards all radio transmissions from

Earth announced that atomic bombs were in use in the current war. The translators have not completed their interpretation, but it appears that the bombs are of considerable power. Two have so far been used. Some details of their construction have been released, but the elements concerned have not yet been identified. A fuller report will be forwarded as soon as possible. For the moment all that is certain is that the inhabitants of Earth *have* liberated atomic power, so far only explosively.

Very little is known concerning rocket research on Earth. Our astronomers have been observing the planet carefully ever since radio emissions were detected a generation ago. It is certain that long-range rockets of some kind are in existence on Earth, for there have been numerous references to them in recent military broadcasts. However, no serious attempt has been made to reach interplanetary space. When the war ends, it is expected that the inhabitants of the planet may carry out research in this direction. We will pay very careful attention to their broadcasts and the astronomical watch will be rigorously enforced.

From what we have inferred of the planet's technology, it should require about twenty years before Earth develops atomic rockets capable of crossing space. In view of this, it would seem that the time has come to set up a base on the Moon, so that a close scrutiny can be kept on such experiments when they commence.

Trescon.

(Added in manuscript.)

The war on Earth has now ended, apparently owing to the intervention of the atomic bomb. This will not affect the above arguments but it may mean that the inhabitants of Earth can devote themselves to pure research again more quickly than expected. Some broadcasts have already pointed out the application of atomic power to rocket propulsion.

T.

From: President.
To: Chief of Bureau of Extra-Planetary Security. (C.B.E.P.S.)

You have seen Trescon's minute.

Equip an expedition to the satellite of Earth immediately. It is to keep a close watch on the planet and to report at once if rocket experiments are in progress.

The greatest care must be taken to keep our presence on the Moon a secret. You are personally responsible for this. Report to me at yearly intervals, or more often if necessary.

K.K. IV.

From: President.
To: C.B.E.P.S.

Where is the report on Earth?!!

K.K. IV.

From: C.B.E.P.S.
To: President.

The delay is regretted. It was caused by the breakdown of the ship carrying the report.

There have been no signs of rocket experimenting during the past year, and no reference to it in broadcasts from the planet.

Ranthe.

From: C.B.E.P.S.
To: President.

You will have seen my yearly reports to your respected father on this subject. There have been no developments of interest for the past seven years, but the following message has just been received from our base on the Moon:

R o c k e t projectile, apparently atomically propelled, left Earth's atmosphere today from Northern land-mass, traveling into space for one quarter diameter of planet before returning under control.

Ranthe.

From: President.
To: Chief of State.
Your comments, please.

K.K. V.

From. Chief of State.
To: President.

This means the end of our traditional policy.

The only hope of security lies in preventing the Terrestrials from making further advances in this direction. From what we know of them, this will require some overwhelming threat.

Since its high gravity makes it impossible to land on the planet, our sphere of action is restricted. The problem was discussed nearly a century ago by Anvar, and I agree with his conclusions. We must act *immediately* along those lines.

F.K.S.

From: President.
To: Secretary of State.

Inform the Council that an emergency meeting is convened for noon tomorrow.

K.K. V.

From: President.
To: C.B.E.P.S.

Twenty battleships should be sufficient to put Anvar's plan into operation. Fortunately there is no need to arm them—yet. Report progress of construction to me weekly.

K.K. V.

From: C.B.E.P.S.
To: President.

Nineteen ships are now completed. The twentieth is still delayed owing to hull failure and will not be ready for at least a month.

Ranthe.

From: President.
To: C.B.E.P.S.

Nineteen will be sufficient. I will check the operational plan with you tomorrow. Is the draft of our broadcast ready yet?

K.K. V.

From: C.B.E.P.S.
To: President.

Draft herewith:

People of Earth!

We, the inhabitants of the planet you call Mars, have for many years observed your experiments towards achieving interplanetary t r a v e l. *These experiments must cease.* Our study of your race has convinced us that you are not fitted to leave your planet in the present state of your civilization. The ships you now see floating above your cities are capable of destroying them utterly, and will do so unless you discontinue your attempts to cross space.

We have set up an observatory on your Moon and can immediately detect any violation of these orders. If you obey them, we will not interfere with you again. Otherwise, one of your cities willl be destroyed every time we observe a rocket leaving the Earth's atmosphere.

By order of the President and Council of Mars.

Ranthe.

From: President.
To: C.B.E.P.S.

I approve. The translation can go ahead.

I shall not be sailing with the fleet, after all. You will report to me in detail immediately on your return.

K.K. V.

From: C.B.E.P.S.
To: President.

I have the honor to report the successful completion of our mission. The voyage to Earth was uneventful: radio messages from the planet indicated that we were detected at a considerable distance and great excitement had been aroused before our arrival. The fleet was dispersed according to plan and I broadcast the ultimatum. We left immediately and no hostile weapons were brought to bear against us.

I shall report in detail within two days.

Ranthe.

From: Secretary, Council of Scientists.
To: President.

The psychologists have completed their report, which is attached herewith.

As might be expected, our demands at first infuriated this stubborn and high-spirited race. The shock to their pride must have been considerable, for they believed themselves to be the only intelligent beings in the Universe.

However, within a few weeks there was a rather unexpected change in the tone of their statements. They had begun to realize that we were intercepting all their radio transmissions, and some messages have been broadcast directly to us. They state that they have agreed to ban all rocket experiments, in accordance with our wishes. This is as unexpected as it is welcome. Even if they are trying to deceive us, we are perfectly safe now that we have established the second station just outside the atmosphere. They cannot possibly develop spaceships without our seeing them or detecting their tube radiation.

The watch on Earth will be continued rigorously, as instructed.

Trescon.

From: C.B.E.P.S.
To: President.

Yes, it is quite true that there have been no further rocket experiments in the last ten years. We certainly did not expect Earth to capitulate so easily!

I agree that the existence of this race now constitutes a permanent threat to our civilization and we are making experiments along the lines you suggest. The problem is a difficult one, owing to the great size of the planet. Explosives would be out of the question, and a radioactive poison of some kind appears

to offer the greatest hope of success.

Fortunately, we now have an indefinite time in which to complete this research, and I will report regularly.

Ranthe.

End of Document

From: Lieutenant Commander Henry Forbes, Intelligence Branch, Special Space Corps.

To: Professor S. Maxton, Philological Department, University of Oxford.

Route: Transender II (via Schenectady.)

The above papers, with others, were found in the ruins of what is believed to be the capital Martian city. (Mars Grid KL302895.) The frequent use of the ideograph for "Earth" suggests that they may be of special interest and it is hoped that they can be translated. Other papers will be following shortly.

H. Forbes, Lt/Cdr.

(Added in manuscript.)

Dear Max,

Sorry I've had no time to contact you before. I'll be seeing you as soon as I get back to Earth.

Gosh! Mars *is* in a mess! Our co-ordinates were dead accurate and the bombs materialized right over their cities, just as the Mount Wilson boys predicted.

We're sending a lot of stuff back through the two small machines, but until the big transmitter is materialized we're rather restricted, and, of course, none of us can return. So hurry up with it!

I'm glad we can get to work on rockets again. I may be old-fashioned, but being squirted through space at the speed of light doesn't appeal to me!

Yours in haste,

Henry.

THE END.

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Swamper

by JERRY SHELTON

The peasant type clings to old ways in the face of any new advance—and, in time, there will be the dull, unchanging peasant type even on other worlds. Like the Swamper—

Illustrated by Orban

The swamp ahead of him was thinning out. Johnson could feel the churning treads of his mud-skeeter bite spasmodically at chunks of solid bottom as he gunned the wallowing machine through the thick green ooze. The worry that had been gnawing, wormlike, at his mind these last seventy periods squirmed up in full strength as he noticed how much even this part of diked swamp had lost water level. His eyes flickered over the exposed shoots of good swamp herbs, drying and rotting for lack of water. The dank musty smell of those fine herbs going to waste made the back of his throat ache.

As the last thinning edges of the swamp slid by, he felt the treads catch firm ground, and the nose of the skeeter began to lift pushing its blundering way through the drooping vegetation. He didn't say anything to Martha or the two kids as the skeeter clanked higher onto dry

ground and the treads began to chew the mangled trailing vines from their metallic teeth. Ahead of them was the last dike that separated Deep Swamp from the outpost town of Dry Point. He wondered what Donavan would say when he saw the pelts and the herbs he had brought in to trade for provisions. He knew the vitamin herbs weren't good. And he knew the swamp-mink pelts were worse. There wasn't even a third of the pelts that had a good rich deep green fur. But a man had to do the best he could what with the water going down and down.

The skeeter was bouncing and banging heavily now on the hard dry ground and he waited for the first ray of sunlight to dart, lance-like, down through the interlacing branches overhead, down into the swamp with its comfortable mist-shrouded semidarkness. The sun had always given him an uneasy feeling. The sun was so bright and clear and hot. If only prices would be right and Mac Donavan would stake him for some fresh provisions.

Without warning, blinding and stinging, light burst into the open cockpit of the mud-skeeter as swamp edge fell behind. Joe Johnson blinked his eyes against the rising clouds of hot dry dust. He heard little Mary Anne give a frightened cry as she jumped to cling to her mother. Mary Anne was only three. She had never seen the sun direct before. Martha told her not to look up into the big light overhead and yanked Little Joe back into the skeeter. Little Joe had been to town before and he wanted to jump out and play in the dust.

Johnson squinted his eyes against the glare of the sun. It hurt his eyes and made his skin feel dry. The circle of fog-dissipaters surrounding sun-baked Dry Point had always seemed like magic to him and more so now because it had been over three hundred and twenty sleeping periods since last he had come to town for supplies.

The machine grunted its way slowly up the rise of the long dike that stretched away kilometer after kilometer to either side of him, and he saw the familiar sun-bleached sign:

DRY POINT

Pop. 421.

He gunned the engines and the nose of the skeeter dipped over, and down into the one narrow street lined with the small one-story buildings that looked parched and thirsty with their cracked paint puffed up into dried and broken blisters. The clanking treads were beginning to make hollow plopping noises in the deep dry dust. It had been a long trip. Now that the trip was almost over he felt that gnawing worry bite at his heart again. He tried to tell himself that maybe things would go all right after all and maybe Donavan might know why his swamp was losing so much water level. If he got drained out another four meters—the Swampanese and the mink and the herbs would die like tadpoles in a puddle. But

his people never had been people to borrow money, and he didn't have any security to offer anyhow—except the swamp farm. His dad's ghost would float up from his grave if he knew credits were ever borrowed on the farm. But if the takings didn't bring in enough he'd have to think of something. Martha was needing things and kids had to have medicine every once in a while.

It was the silence he noticed first. And then the emptiness. And then the boarded up windows. As the skeeter rumbled down the street, despite the heat, Johnson felt a slow chill settle down his back. The street was deserted. There were no swampers sitting under the tattered green sidewalk awnings, drinking and gambling and gossiping. No mud-skeeters snorted and clanked up and down the dusty street. Dry Point looked like it was dead. Like a ghost town.

He felt Martha's anxious eyes searching his face. "What's wrong, Joe?" she asked in her low quiet voice as she tried to keep Little Joe from excitedly jumping out of the skeeter.

"Don't know," he said. "I don't know yet. Gonna see Mac. He oughta know something." He squinted against the blinding clouds of dust and finally made out the Trading Post sign swinging slowly in the faint breeze. He wished he could think of something else to say to Martha but he couldn't think what it could be. Martha had been looking forward to this trip. Martha didn't get into town very often to look at all the pretty city-made things. He knew it got lonesome for Martha out in the swamp with no one for her to talk and gossip with. He had figured this trip would do her good. She could sit under the awnings with the other swamp women who had come to town to visit and gossip while their men did the trading. Women liked those things. Even Martha. And now something was wrong. Maybe they had stayed out in Deep Swamp too long.

He swung the skeeter up under the sign, pulled back on the brake handles and locked them as he switched off the engines. He put on his shapeless hat and loose-limbed, climbed down to begin examining the worn treads with care. The treads were still wet from the long trip through the dripping swamp and with thick, work-hardened fingers, Joe Johnson took his time scraping away the hot mud and the caked Dry Point dust. He wasn't a man to waste motion. His tall lanky body had poled too many weary kilometers through the misty depths of his swamp farm in his wooden floater, bartering with the Swampanese natives for deep-bottom herbs, and then tending his own swamp-mink traps, to not know how to save waste motion. Equipment was expensive this far west on Venus. A man had to take proper care of what he owned.

He straightened up, wiping his hands on his patched green jumpers, and noticed that even the Swamp End Hotel, right across the street, was closed. Boarded

up tight as a sprung mink trap. He couldn't put things off any longer. He had to do it. He dreaded going in to ask Mac what he had to ask him.

"Martha?" Joe looked up at her. Martha had a pin in her mouth. She was tying a bright blue ribbon in Mary Anne's blond hair. "You comin', Martha?"

It was nice married to Martha. Her eyes were—you never could quite catch them. Her eyes were mostly silent and quiet and away as if she was thinking about something nice all the time. Martha only looked at you direct when she had something to say—and then her eyes were warm, rich and brown, expressing the seldom used words in a steady sort of way. Martha never complained. Except to tell him not to work so hard. She never bothered a man when he didn't need bothering. She only talked plenty when she was answering Little Joe and Mary Anne with their endless childish questions—and that gave him plenty of time for thinking. He had been doing plenty of thinking lately.

"You go ahead, Joe," she said gently. "You've always been a good man. Everybody in swamp knows that. If something's wrong, I guess they know you'll figure a way how to fix it."

The dust made Joe's eyes smart. "Guess I'll take the herbs and pelts into Mac now."

He moved around to the forward locker where the tightly packed bundle of pelts and the box of dried herbs were stored. He could hear Martha giving Little Joe instructions. "Stay with your dad. Don't bother him with questions. Keep ahold of Mary Anne's hand. You can let her play in the dust if she wants to, but don't let her put anything into her mouth. When you get hungry come back. I've got some fixings I made this waking." Then louder, he heard her call: "Joe—I put two jars of that swamp-root tea I made for Mrs. Donavan in with the pelts. Give them to Mr. Donavan and tell him it will be good for his wife's damp pains—and ask how his dad is feeling now."

The kids climbed down. Joe watched them. Little Joe was almost nine and getting rangy. He was bubbling with excitement, but he didn't forget to be big brother enough to help Mary Anne down from the skeeter and hold tightly to her pudgy fingers. Little Joe had Martha's dark brown eyes, but Mary Anne got her eyes from him. Deep, deep green—green as swamp water. And Johnson could see her eyes were bigger than usual. This was her first trip to town. He watched them scamper around behind him and felt them cling to his long legs. He looked up at Martha.

Joe's throat was tight. "I sorta thought you might want to go in and look at the pretty things, Martha. Maybe you need something."

"No," her voice was soft, "you go ahead, Joe. I'll just sit in the sun awhile." She smiled one of her little smiles at him. A smile just like the shy smile she had had

for him on the period he had paddled all the way over to her dad's small swamp farm on their marrying day. "You go ahead, Joe."

"Maybe I'll get the kids something —if prices are right." He knew the prices couldn't be right. Not with these pelts he was bringing in. The herbs wouldn't bring much. And he had to get provisions and petrol and medicine and a lot of things.

Expertly, he swung the heavy bundle to his shoulder and with the kids whooping at his heels he stalked into the post.

The semidarkness was cool and refreshing. The six long counters were packed and jammed, overflowing with a disordered jumble of city-made things. Blanketing everything was the dry yellow dust that whirled constantly through the open doorway.

The strange smells and the bright colors made Little Joe quiet down in fascinated awe. Mary Anne's wide green eyes hardly ever blinked so intense was her wonder.

"Don't touch nothing," he said, and the words were a pain, as Mac Donavan waddled toward them, his fat red face grinning despite the drops of perspiration that dripped from his chins, soaking his blue workshirt. He was as bald as a turtle egg.

"Joe—you old mud-eater!" His soft seeming hand closed with surprising strength on Johnson's calloused fingers. "Glad to see you. I was getting sorta worried about you staying out in Deep Swamp so long, out of touch with everything. How's Martha? Got any more kids?" He looked down at Mary Anne, who was half hiding behind and half clinging to Little Joe's square-set legs. "Well, well—where did you come from, Green Eyes? Never saw you before. Here—" He pulled out two pieces of candy and squatting laboriously, he held them out.

Little Joe put an arm around Mary Anne. They both backed up a step. Little Joe's mouth worked as if he were swallowing liters of saliva. But he didn't put out his hand. He stood there holding Mary Anne, whose big green eyes stared at the candy in childish innocence. She didn't know what candy was.

Johnson felt a guilty hurt sweep through him. It was rough some of the time, teaching your kids to stand on their own hind legs and to not take nothing that hadn't been worked for. But it warmed him to see Little Joe stand and take it.

Mac grunted himself to his feet. He placed the candy on a low counter. "Tell them they can have it, Joe, or your boy is going to drown in his own spit."

"He can buy his own candy after you grade the pelts," said Johnson roughly. "He's got about a dozen of his own in here from his own traps." He walked into the weighing room and swung the bundle down by the scales. He whipped out a sharp skinning knife and cut the thongs. "Got some swamp-root tea for your Missus. Martha

made it. How's your old man?"

Mac looked away from Johnson a moment before he bent his head and began to sort the pelts into three piles—good, average and not-so-good. "Dad went Earth," he said without raising his head. "He couldn't stand to see the swamps going. 'Bout broke his heart."

Johnson stood still. There wasn't a sound except for Mac's heavy breathing. He forced the question slowly, "The swamps going—?"

Mac Donavan raised his head. The soft smile was gone. His lips tightened over his teeth, but his eyes seemed as dead as wet ashes. "I sort of had a hunch, Joe, that you didn't know what's been going on around here. I told you last time you should of bought new tubes to repair your Video. A man can't afford to stay out in swamp as long as you do and not keep in touch with things. Maybe since your family is the oldest swampers in these parts you could of done something with them. They might have listened to you, Joe. But now it's too late." He pulled out a wet handkerchief, wiped his fat face and blew his nose.

"The swamp—?"

"Finished!" Mac waved his hand. "They all sold out. What swampers ain't left yet, are fixing to leave right soon. Some city fellow from Earth came in and bought them all out. He's draining the swamps he already bought with some sort of a water-vaporizing contraption. That's where all the water is going. And when all the water is gone he's going to bring in city workers with machines and harvest the herbs by the ton. And they don't need wild swamp-mink fur any more. Some smart-Aleck started breeding and raising them under scientific care and gets better pelts than you got here."

"But why did the swampers sell out? Where will they go? People can't just up and leave the swamp they was born and raised on. Why they'll—"

"Don't know, Joe, except he started feeding them guff about what a hard life swamp life is and how nice it is in the city. He started selling bright stuff to the women at prices he said they could get in the city and telling them about sending their kids to city schools. Anyhow, he did it. Your farm is the only farm he ain't got. But he'll get it. When he drains all the others you'll be hurting for water level. How's it been going out your way?"

"We get along," said Johnson slowly.

"Been drained out any?"

"A little."

"How much?"

"About two meters."

Mac whistled, and looked down at the pelts. Mechanically, he began to sort them again. "You and Martha can't go on that way, Joe."

"Maybe so—maybe not. But I been diking all around my place now for seventy periods. Ever since I started hurting for level. Holding pretty good too." Absently, he stared at the three piles

of pelts. The not-so-good was the biggest.

"These ain't so good, Joe."

"I know." He felt his jaw clench. "I ain't going to sell."

Mac's fat fist slammed the counter. "What's going to happen, Joe?" How's all this going to end? You can't go on like this. If all you swampers had held out together, then it might be different. But even if he had been able to buy a few swamps and started dissipating the water it would ruin those that tried to hold out. That water would settle. In another four hundred periods the swamps will be dry and he'll be scooping in all those vitamin herbs by the ton. The swamp minks will die off. All the places here in Dry Point are either closed or they're closing down. This town is finished—dying!"

"I ain't going to sell my swamp."

Mac's voice became louder. "Joe, listen to me. For Martha's sake. And the kids. Why don't you take the credits before he ruins you? I can't pay you much for these pelts. They can't compete any more with those commercially bred furs—and these here herbs won't buy you provisions for a hundred periods."

Like a retreating wave, Mac's outburst subsided. He wiped his face with his soggy handkerchief. "I'm sorry, Joe." He swallowed. "Things are different from your dad's time and my old man's. Me and the Missus are going to have to leave, too. That city fellow said those scientific workers that'll come, will laugh at me if I tried to sell them any of the junk I sell you swampers." He looked around his store. "I always thought the stuff I sell was pretty good. But maybe those workers would think it was just junk like he called it. So now I got to figure how to get rid of this stuff somehow." He busied himself weighing the pelts. "Maybe I'll go Earth. Always did want to see that place and some big buildings just like on the Video. Don't know what me and the Missus will do in one of those places though."

Johnson hitched the belt of his jumpers tighter. "What about the Swampanese? What's going to happen to them? Take away their swamp water and they'll die."

I asked him about that. He said he didn't think Swampanese were people. Called them underwater monstrosities."

"WHAT?" The word was loud and sharp. Johnson was startled to realize that it had been himself who blurted it. "Underwater monstrosities he calls them? And he don't think they are people? What does he know about the Swampanese? Those people been here in their swamp waters long before the first Earth man ever set ship to this planet. My granddad was the first man to ever work out a system of slap-talk with them." Joe's voice had risen to a roar. He realized he was clenching the edge of the counter with a grip that made his fingers hurt. "What's he going to do with them? Let them drown in the air? That's murder!

He can't murder a whole race of people!"

"But, Joe—those city people don't look at it like we do. They don't know the swamps. He said that if they had a recognizable culture that maybe he and the courts could do something for them. He said he didn't see how people could read and write and all that stuff and live under the water." Mac's voice became grim. "But he did say he planned to take some of them and ship them to Earth where he would put them on display in an aquarium or something like that."

"Display—" Johnson could feel his teeth grinding. "If he takes those people away from the swamps they always lived in, they'd go crazy. They'd die. They'd die like tadpoles." Joe Johnson slammed his two gnarled fists together and began walking up and down the aisle.

"Why couldn't we all chip in and buy them a section of swamp of their own? Make sort of a reservation. I could dike it up good for them and watch the water level?"

"You got any credits, Joe?"

"No, but—"

"Neither has anyone else that would see it your way. Anyhow, if you tried to borrow money to buy a reservation—"

"I'll give them my own swamp."

"Ain't big enough for all those Swampanese, Joe. And if you did borrow on your own farm—how you gonna pay it back? How you gonna pay even the interest? Those credit fellows want to make credits off their credits. You can't do it that way."

"Where is this city fellow?"

"Konsello?" Mac shook his head. "He's up the street a piece. Won't do you any good. What you want to see him for?"

"There's more than one way to bait a swamp-mink trap." Johnson jammed his hat on his head. "You go ahead and figure what I got coming. And also Little Joe. When I get back I'll pick up what I got enough to pay for. And something for Martha. A bright red hair ribbon if you got one. She likes red."

Johnson strode out of the weighing room into the show room. He saw two tiny noses pressed hungrily against two different show cases. Little Joe was looking at skinning knives and mink traps. Mary Anne was fascinated by the dolls with removable jumpers. Johnson felt a long forgotten longing. He remembered when his own dad used to bring him in here when Mac's dad ran the place. He remembered when he had saved his own skimpy pelts two whole seasons so he could buy his own first set of traps. And his first sharp skinning knife. It almost gave him a lump in his throat.

He went out the door. The kids didn't see him go. Stepping into the hot blazing sunlight he saw Martha still sitting in the skeeter. She shouldn't sit there too long. Might make her sick. But Martha always knew what she was doing. As he walked toward the machine

he saw her sewing another patch on Little Joe's extra jumper. Whatever credits he had coming he'd have to stretch them somehow to get the kids some clothes. Martha didn't look up as he passed her and he didn't say anything. There wasn't anything to say. He had to do some thinking.

His mud-boots scuffed up choking clouds of dust. The empty street didn't seem right. He remembered hearing about other Venus frontier towns when the planet was first opened for colonization. Some of them had been big and booming towns. And he remembered how his dad talked about those towns turning, almost overperiod, into dead ghost towns when the business, or the reason for the town's life had died or moved on, sucking the life out of the place. Surely this couldn't happen to Dry Point! Or the swamps! The swamps had always been here. And the Swampanese with their underwater way of life—they had always been here. It just didn't seem right to drain the swamps. He had to think of something. He felt his mind turning the problem over and over and coming up with no answers.

Dry Point looked like it was dying. Most of the places were closed and boarded up. Only two bars and one restaurant were still open.

On an impulse, he pushed through the swinging doors of MIKE'S MODERNE BAR AND BUFFET and looked around. The place was empty except for the bartender who set up a glass, and said, "What'll it be, swamper?"

Automatically, Joe's right hand

went down into his pocket. It came out empty. He felt his tongue twitch, but he said, "Nothing." He walked closer to the bar. "Seen Adams, or Walker, or Vorseen, lately?"

The bartender began polishing the bar with a dirty rag. "They all left couple of periods ago. Sold out to that Konsello fellow. Seems like they made deals with him."

"Thanks," said Joe, and turned to go.

"Wait a minute." The bartender reached for a bottle on the plasteen shelf behind him. "Have one on the house. I'll be leaving pretty soon myself." The neck of the bottle made a tiny ringing noise as it touched the rim of the glass.

Johnson listened to the liquid trickle with wet splashing gurgles into the glass until it reached the top and stopped. The heady smell of the whiskey in his nostrils brought the saliva popping into his mouth. He looked at the filled glass and his body tightened for a moment and then relaxed. "No thanks," he said.

"O. K.," said the bartender and drank it himself.

The swamper turned and pushed through the doors to the hot street. His throat was parched and dry. Must have swallowed some dust, he thought. If Adams and Walker and Vorseen had left already, then that meant he was the last swamper. Whatever slim chance the Swampanese would have was now up to him. And if he didn't think of something soon the Swampanese would die. Like tadpoles.

He searched for Konsello's sign. He couldn't miss it. It was big enough. The sun hadn't even bleached the lettering yet.

RECLAIMING ENTERPRISES

G. B. Konsello, Exec.

He walked over and hesitated before going in. He looked down the street at Martha. She must have been watching him because she waved once. He couldn't see her face clearly, but he guessed she must have smiled. Without returning the wave he turned and entered.

The office was shiny and cool. He could hear the hiss of an air-conditioning unit somewhere. Joe took off his hat and looked at the broad back of a man who was sticking colored pins into a swamp map on the wall. The office was full of the smell of new paint and there were many overstuffed things to sit on. Unconsciously, Joe began to rub one foot against the other to scrape off mud that wasn't there. He cleared his throat.

The man turned. Everything about the man seemed to be big and solid. Face, head and hands. He was big shouldered with a full chest like a petrol barrel. But Johnson didn't like his face. His face seemed full of a bitter arrogance.

"Hello," he said, in a voice that had the timber of a man who was accustomed to issuing orders he ex-

pected to be obeyed. "My name's G. B. Konsello. Haven't met you before. What can I do for you?"

"My name's Johnson."

"Oh—Johnson!" A frown creased the broad forehead for an instant. His oil-black eyes frisked the swamper. "You're that fellow way out in Deep Swamp. I've heard talk your family was the oldest family around here. Sit down—" His big hand made a sweeping gesture. "I've been wondering how I was going to get a chance to deal with you. Have a cigar—"

Johnson ignored the extended box of cigars. "Did you say my family *was?*" he asked in a tight voice.

Studying the swamper, Konsello held the cigars out for five more seconds. "Johnson!" He snapped the lid of the box shut and put them away. "I must be blunt. You swampers are finished here on Venus. You're too far behind the times. Sooner or later, civilization always catches up with the frontier and the frontier is a frontier no longer. You've served your purpose, and now civilization is extending this far west. I am going to drain these swamps and collect the herbs in a more business-like way. Dry Point will be torn down and a more modern industrial town will be erected. I have leased this land from the Old Earth Agency. I am prepared to offer you a fair price for your land."

Johnson shook his head. "What's going to happen to the Swampanese when you drain away their water?"

Konsello's frown deepened. "Some sort of plan will be made to transport as many as will be economically possible to Earth where an aquarium arrangement of some sort will be set up. How much do you want for your land?"

"Mr. Konsello"—Johnson turned his hat slowly in his hands—"I never was much with words. But that don't seem right to me for you to take those swamps away from the Swampanese and put them in a strange place. I don't think they could stand it. Those people are people just like us. They have feelings like—"

Konsello snorted. "Do you call those underwater monstrosities *people?*"

A deep red began to mount up the back of Johnson's neck. The words came out with effort. "Mr. Konsello, I know how I feel about my own swampland. A man gets to love his own land. My dad's father lived out there and my dad buried him there. I buried my own dad out there, too." He waved his hand. "A man can't just up and leave what's always been his." He leaned forward earnestly. "Maybe I could leave if I had to, because maybe I could understand the reason why I had to leave. But those Swampanese couldn't *ever* be explained to. Slap-talk ain't that fancy as a language. And they've always lived there. They'd die off like tadpoles in a strange—"

Impatient, Konsello got up and

stepped from around in back of the desk. "I don't know about that, Johnson. This is the last big swamp left on Venus and when all the others swamps were drained this question was never brought up. No one ever considered them as having intelligence as we know it, and draining the swamps proved to be a profitable venture. Why should this be an exception? And your father never did buy the land in the first place. You don't even legally own that land, Johnson."

"But my family has always lived there. It's our swamp. We diked it and took care of it and learned to make friends with the Swampanese. We gave them a chance."

"I'm sorry. I must make a profitable showing. I've been a captain on a spacetug all my life running ore. But now the medics say I'm no good. Too much canned air and all that." He looked up at the ceiling, and for an instant, the bitterness seemed to leave his broad face. Then without looking at Johnson he moved behind the desk, sat down and picked up a stylo. "I saved my money, swamper, for the day they would throw me out and ground me. They gave me this chance. I'm going to make the best of it. How much?"

"How many credits would it cost to set up a place—sort of a reservation for the Swampanese to live on, Mr. Konsello? I'll give in my swamp for nothing."

"More than you could ever get together. I need those vitamin herbs now. Some day, some laboratory will discover a way to make it synthetically and this swamp country will be worthless. But right now, Venearth Laboratories will buy as much as I can ship them. By the ton. So I'm going to drain the swamps. How much for your land?"

"Then there ain't any chance of making some kind of a deal with you to save the Swampanese here on Venus?"

"No."

Johnson took a long breath. He looked down studying the worn toes of his mud-boots. "You never been in the swamps or never saw a Swampanese did you, Mr. Konsello?"

"No."

Taking another long breath, Johnson said, "I'll make you a bargain. If you come out to Deep Swamp —maybe I'll do it."

"I don't have to make any bargains. I've got to have that land regardless of what your decision may be. If you force me to, I can take the necessary legal steps to take it to court and the court costs will come out of your sales price in the long run. But I don't prefer to do business that way." He looked at Johnson narrowly. "I have wanted to make an inspection trip through swampland in the hands of an experienced guide to inspect herb concentrations, depth of water and a few other details. I have heard the swamps are dangerous to the inexperienced. I would be glad to pay you for your services."

"Mr. Konsello"—Johnson's big hands closed like a vise on his

tattered hat—"to take you on a personally conducted tour through my swamp will be pay enough."

Konsello's eyes shot down to the tightly clenched hands and the knuckles, showing white. He opened his mouth as if to say something, then snapped it shut like a trap. He moved his massive bulk around the desk until he stood squarely in front of Johnson. Their eyes locked.

"Look here, swamper. If you think—" said Konsello, and let the sentence trail off into a flat silence.

For the space of three heartbeats, neither man moved. Then unexpectedly, Konsello let out a snort. He began to laugh as he moved to his desk and took out a shoulder holster complete with blaster. He slipped into the harness and snuggled it around him with the ease of a man accustomed to wearing it. Yanking out the weapon he checked the fuses and rehung it. He pulled a sun helmet out of a locker and said, "Let's see your swamp, swamper." He went out.

Without hurrying, Johnson put on his hat, walked through the door and turned toward the mud-skeeter and the trading post. The two men shuffled through the dust in silence, past the mud-skeeter. Martha only looked up briefly and returned to her sewing.

As the men clumped into the trading post, Little Joe started whooping and came dashing up waving a brand new skinning knife in his right hand, and dragging half a dozen shiny mink traps with the other. The whooping died suddenly as he saw the stranger behind his father. His lean face went blank.

"Where's Mary Anne?" Big Joe's voice had the sharp edge to it that Little Joe knew so well. He knew his father was in no mood for play. He knew his father had serious things on his mind. Things more important than the new knife and the new traps.

Without a word he let the chains of the mink traps slip to the floor with a metallic crash and raised his hand to point into the other room.

Joe Johnson started toward the inside room and halted in midstride. He turned. "Let me see that knife and those traps, Little Joe." He honed the knife against his hard palm and tested the pans and the springs of the traps. "Those look plenty good to me, Little Joe," he said gruffly. "You must have had some good pelts in there or you outtraded Mac." He swung off into the other room as he saw the boy's eyes brighten, and then, whooping again, he scooped up the traps and scrambled out the door to show them to Martha.

Johnson was glad he hadn't been too busy to notice the new things Little Joe traded for his first pelts. He remembered that time, so long ago, when he had brought in his own first pelts and his dad had been too busy to notice. The knife hadn't seemed so sharp after that. And the traps not so tight.

He heard Konsello following him

as he walked in to find Donavan squatting on the floor with Mary Anne. He was trying to show her how to fit a mama and papa doll outfit into a toy floater about a meter long. The dolls wouldn't sit up right, and Mary Anne, her pink face smeared with candy, was chortling with glee as she waited to put in the two babies.

"How much I got coming, Mac?" Johnson tried to take the sharpness out of his voice.

Donavan looked up smiling. As he saw Konsello, the smile died. Breathing heavily, he forced himself to his feet while Mary Anne continued to chortle over her dolls. "Got it all packed on the weighing counter. I sorta figured out what you'd want from what you always take. Found a red hair ribbon and some other stuff. Pelts were better than I first thought."

Johnson walked over and hefted the bulky package. "Those pelts weren't that good, Mac. You know I don't—"

"All right, Joe. Call it a loan. You can send it to me if you make out all right. Here's the ribbon for Martha."

Johnson took the ribbon and put it into a pocket of his jumpers. "You and the Missus might be gone next time I come in?"

"Maybe. But we won't be leaving for awhile yet. Tell Martha good-by anyhow though."

Johnson shouldered the package and started for the door with Mary Anne toddling after him firmly clutching the dolls and the floater.

"Hold on." Konsello broke in with his brittle arrogant voice. "I can guess what you men think of me. But it doesn't matter. Why don't you think of your kids, Johnson? You can't give them a decent education here in the swamps. Send them to a city school and they'll really learn something."

Johnson eyed him coldly. "Martha and me and the kids get along. The kids can't learn nothing in a city school about how to run a swamp farm. My dad didn't go to school and his dad neither. Martha and me teach Little Joe and Mary Anne what they need to know and we bring them up right, to not take nothing that they didn't work for."

"The city's got a lot to offer you can't get in a swamp."

"Martha and me got happiness. That's a lot more than a lot of you city people got. Martha wants me and I want Martha and we both want our kids. And the swamp. Come on, Mary Anne."

Out in the hot dusty street once again, he packed the bundle into the forward locker and swung Mary Anne up beside Martha and Little Joe in the back seat. Ignoring Konsello, he climbed into the driver's seat, kicking the motors into life. He felt the vehicle lurch as the city man's weight settled into the starboard seat beside him. Gunning the throttle, he pulled back on the left brake handle and the right tread walked the skeeter around in a tight circle throwing clouds of dust down the deserted street. As he pushed both brake handles up into free, he saw Mac

Donavan waddle out into the sunlight. The trader didn't wave. He just stood there and watched them go.

In minutes they were nosing up over the dike and pushing through the first vegetation fringing swamp edge. Finally, when the comfortable semidarkness swallowed them he stopped the skeeter long enough to reach in his jumpers and give the hair ribbon to Martha. "Thought this might look right pretty, Martha, if you twisted it in your hair like you used to do that other one."

Martha held it up and looked at it. "It's pretty, Joe, but you should have got yourself something." She folded it carefully and put it into her sewing bag. "I better put it away for now so it don't get wet from the tree drippings."

Johnson released both handles and the treads plowed into the green ooze. Slowly, the swamp began to slide by. Cool, green, semidark and quiet except for the throbbing of the engines and the slosh of the revolving treads.

Four hours crawled by and there was no conversation except for the excited chatterings of Little Joe and Mary Anne retelling all the things they had seen in town. Occasionally, Johnson glanced at Konsello but offered no comment. The big man was hunched down in his seat silent, but watchful and alert. His narrow eyes were taking in the water level and what other things that were of interest to him. The water, dripping from the low-hanging tree limbs, was beginning to soften up his sun helmet and he took it off and put it under his knees.

When the swamp deepened and the skeeter began to float smoothly over the quiet green waters, Johnson stopped the machine and let Martha break out a box of small dried salted fish along with a few shoots of young herb roots. Konsello accepted his share with a brief nod, and they ate in silence. When the food was finished the two kids snuggled up to Martha and were soon asleep.

Johnson drove on, hour after uneventful hour, until finally he heard Konsello snoring beside him. The dim light was beginning to fade into a deeper gloom and he pushed the aged machine to the limit. He had to make his place in Deep Swamp before complete dark. It was death above water level, in the open, after blackout. He knew what it meant if the dark-flies caught a man and stung him, laying their eggs deep down in the warm flesh. That turned a man into a walking food supply for the young dark-flies and it was a long and painful death. Venus, with her slow revolution, wouldn't turn this part of her body to the sun for another sixty-two hours.

The homing light, bobbing slowly in the gloom, was like a beacon saying he was welcome home. He felt the skeeter pull up the rise of his own dike, and as he broke the photobeam, his Bailey hut ahead lighted up and the doors swung

open. He lumbered up the ramp and inside.

Almost automatically, Martha and the kids woke up. Johnson shook Konsello awake and they climbed down into the storage room and went into the combination living room and adjoining kitchen. With a nod for good night to Konsello, Johnson went into the bedroom to sleep while Martha put the kids to bed and fixed a place for Konsello to sleep on the couch in the living room.

Johnson took off his mud-boots, and without removing his jumpers he lay down and closed his eyes. He could hear the night swamp sounds begin to filter in through the metal walls. It was good to be home. Back in the swamp. His own swamp. And now that he had Konsello out here, how was he going to make him see that it wasn't right to drain the swamps and kill everything in it? He had to think of something.

Almost instantly, it seemed, he was awake. But he must have slept a long time, he thought, as Martha wasn't beside him. He could hear the rumble of Konsello's arrogant voice from the living room. He walked out and saw the big city fellow sprawled out in his own chair that nobody ever sat in but him. He had Little Joe and Mary Anne sitting at his feet. He was telling them about an adventure in deep space when an outlaw ship had tried to highjack his cargo. Little Joe's eyes were shining, and because her big brother was interested, Mary Anne was listening too, although she didn't know what a spaceship was. Johnson's hands clenched. The city fellow was walking in here taking over like he owned the place. Like he was trying to take over the swamps.

Stalking past the group, he mumbled a curt greeting and went out to the kitchen, where Martha quietly fixed him breakfast. When he had finished and pushed the vessels away he opened the bundle from Donavan and sorted the contents. There was more here than he had imagined: Medicine, canned goods, spare tubes, sparkplugs, fishhooks, line, whetstone, new boots and many other things he had been needing.

When he looked up he noticed Martha had the new ribbon twisted in her hair the way he liked and he told her it looked pretty, and she smiled and brought him his empty pipe and gave him some tobacco she said she had traded Mac for some preserves she had put up. When he had got the pipe going good, Johnson went out to the storage room and began to work on the motors to the skeeter. He worked steadily, and Martha brought dinner and supper out to where he was working. When he finally did come back into the living room he was tired and heard Martha and the kids laughing at something the city fellow was saying.

Konsello looked at him with his sardonic smile. "It must get pretty dull and lonesome for Martha out here in nowhere."

"You mind your own business."

Johnson found himself a place to sit down and rest.

"When you going to take me out into that big bad swamp of yours? An old spaceman gets a little cramped in here."

"Soon as it gets light."

"Then you going to tell me all about the swamps."

"I can talk better out there."

"Think you can talk me out of taking over your land?"

"Maybe."

And so it went, the waking period drifted into a sleeping period, and another waking, and another sleeping. Johnson didn't do much talking or spend much time in the living room with Konsello and the kids. He kept doing the jobs he had to do. Finishing up the overhaul on the skeeter. Fixing up some traps that needed tightening. Working on some mink pelts that were too fresh to trade. And all the while, Konsello sat in his chair and talked to the kids, telling them about spaceships and big cities.

When the soft light came, bringing the final waking, everything was ready. Johnson packed extra petrol into the forward locker of the skeeter and slipped a long knife into his jumpers. He climbed into the cockpit as Konsello came out carrying Mary Anne, with Little Joe tagging at his heels. Little Joe was shouting something Konsello had taught him: "Seal the port lock, blast off and all men into battle gear!"

After Martha had stowed some food aboard, the city man handed Mary Anne over to her and climbed heavily into the skeeter. "Nice bunch of kids you got there, Johnson. You'll all be much happier in the city. Send that boy of yours to a real school and he'll be able to get himself a decent job instead of grubbing his life away in all this muck around here. He might even make a spaceman."

Johnson grunted, and kicked on the motors as he caught a look from Martha. Martha was looking at him. Her face was strained. She came over to him. She looked up at him and put her hand on his arm.

"Joe," she said softly, "what you going to do?" Her eyes were wide and brown and troubled. "You'll be careful, won't you?"

He reached down and patted her cheek. This wasn't like Martha. What was she thinking? He began to check his meters on the instrument panel.

Konsello's rasping voice broke in. "Well, do we start, or don't we?"

Stepping on the throttle, Johnson listened carefully to the wheezy old engines as they warmed up and checked the manifold pressure. When he was satisfied, he nodded to Martha to open the doors.

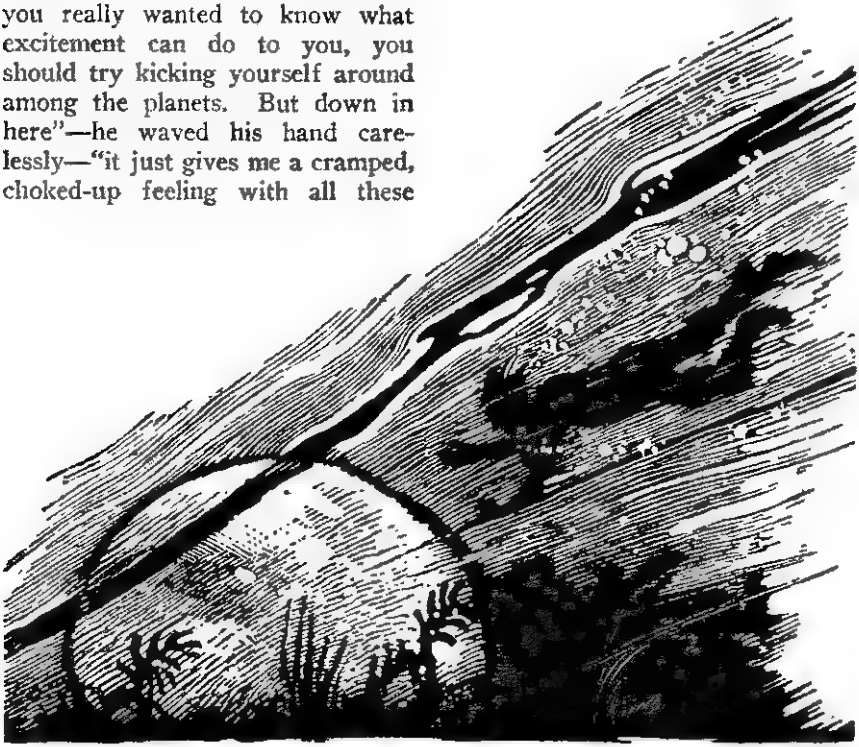
The heavy skeeter walked clumsily down the slanted ramp until it splashed into the water and floated, bobbing slowly on the smooth green surface. Some water birds fluttered out of the way.

All around them the trees writhed upward into the ever

thickening mist that swirled up from the water until their twisted arms interlaced into a roof like the roof of an enormous cathedral made of green marble. Narrow canals, cutting open swaths through the choked vegetation, radiated out from the Bailey hut like the spokes of a gigantic wheel and murmuring echoes of the waves the skeeter had started, bounced back with soft gurgling voices as if the quiet swamp waters resented being disturbed.

Konsello looked around. "So this is the terrible deep swamp." He yawned. "I think you swampers build up the danger of swamp life just to make conversation. If you really wanted to know what excitement can do to you, you should try kicking yourself around among the planets. But down in here"—he waved his hand carelessly—"it just gives me a cramped, choked-up feeling with all these half-dead trees with their roots sticking out of the water and standing around wrapping themselves around each other as if they didn't have the strength to hold themselves up without help. When I drain away the water and put in fog-dissipaters it will make a big improvement."

Johnson sent the skeeter splashing down the canal on the left. "Maybe that's the way you look at it, Mr. Konsello," he said and felt the anger sweeping into his voice. "But didn't you ever think maybe us swampers like it this way?" He gunned the motors savagely and the booming backfires



caused the birds to screech dismally and flap hurriedly deeper into the swamp. "Where you want to go first?"

"I want to see some of these Swampanese and how they live."

Johnson gave him an odd glance. "How they live—?"

"Sure," said Konsello, making himself comfortable in the seat. "And I want you to explain to them about the plans I have for their future when I drain away the water. If they are as civilized as you say they are"—he paused and gave the swamper an amused smile—"they will realize I am acting in their favor. Although nothing compels me to. *If* you can really talk to them."

"I can talk to them all right," said Johnson grimly. He shifted the skeeter into higher gear and the deep treads began to dig more swiftly into the water. "But swamp talk never was a fancy language for explaining complicated things. It works all right for trading and bartering. I guess you don't know much about the swamps, do you, Mr. Konsello?"

"The swamps?" Konsello made a scornful sound. "I've been a spaceman all my life. The true life for a red-blooded man." He rubbed his big hands together. "Adventure and excitement with danger thrown in every minute of it. That's what makes a man's blood tingle. But this swamp stuff with the quiet waters all around and the half-dead trees and catching little minks in traps—bah! I'd go crazy in no time locked up down here. A spaceship might be pretty crowded, but at least a man can move it and himself around."

"You mean if you take a man out of his own environment and put him in another one he don't like it?"

"That's natural."

"What about what you're trying to do to the Swampanese?"

"Look, Johnson, that's different. Don't try to talk me out of it on that angle. In space there's excitement and danger—"

"There's things under this water that ain't so nice."

"Rubbish!" Konsello laughed, and whipping out his blaster shot from the hip, sending a hot blasting needle of energy roaring up into the trees. A thick limb fell with a watery crash. "Nothing in this half-dead swamp could stand up against this thing for five seconds. When I was a lad on my first planet-fall liberty I had already killed a man. In those days it was considered a dull trip if we didn't get holed by a meteor or if a tube didn't blow or a highjacker didn't try to get your cargo. I remember once, just about turnover time, on the Mars run when—"

As the skeeter continued, chugging its way deeper into swamp, Johnson listened to Konsello's boastful stories of far-away planets and long-dead space battles with only half a mind. His previous worry, about the falling water level, now seemed only a small part of the uncertainty that filled his brain. It wasn't merely a ques-

tion of trying to hold water. It was more of a job trying to find a way to fight man-made rules, and laws and technicalities. Johnson knew he didn't know much about the way those big courts worked. Hadn't Konsello said those courts could force him to sell his swamp land and he'd have to pay the salaries of the men that would take away his swamp? There wasn't going to be any simple way out of this.

He glanced at Konsello seeing the arrogant tilt to the big man's head and a sudden idea swirled up before he could stop it. *Suppose Konsello didn't make it back from this trip? Accidents happened all the time in swamp. How easy it would be to just—* No—he fought the idea. Murder was murder no matter how it happened. The thought was insistent. *Now wait —think a moment—no one would ever know. The swamps always kept their secrets, didn't they? And he was going to kill off all the Swampanese, wasn't he?*

Abruptly, Joe Johnson noticed the palms of his hands were sweating. The brake handles were slippery in his grip. He could feel himself begin to tremble and shake all over. A tremendous tension was clutching him as if a conflict of wills were going on way down deep inside of his mind below the level of conscious thought. He felt sick. He had never considered killing another human before. Even the slight thought of it, put a tight constricting pressure on his chest, stopping his breathing as if an iron band had been clamped around his lungs. But he couldn't let Konsello go back to Dry Point now with plans on ruining the swamp, could he?

"Johnson!"

The city man was shaking him. "What's the matter with you? Are you blind? You almost hit that tree root. Where we going now? It's getting awfully thick in here."

Shaking off the hand, Johnson said thickly, "I know where I'm going, Konsello. You do the riding. I'll do the piloting."

Silent, the big man settled back into his seat. He began to watch Johnson through half-closed eyes as the swamper continued to send the skeeter plunging ahead, deeper and deeper into the thickening swamp.

Overhead, the green roof was coming lower and lower with each passing minute. The trees seemed to be marching up closer and reaching out twisted arms that they wrapped tightly around their brothers. The channel of clear water had narrowed until now the machine could hardly get through.

Johnson pulled back suddenly on the brake handles. He let the skeeter drift to a stop against a tree trunk, shutting off the engines.

"Now what?" asked Konsello in a low voice.

Standing up, Johnson pointed over the side. "Down there. In that."

Konsello peered over the side and saw a hollowed-out wooden shell about five meters long. "That

flimsy thing?" he exploded. "What's the idea?"

"You want to see some Swampanese," said Johnson softly. "They're farther down in deep swamp. The skeeter can't get through that far." Picking up the food, he climbed down to the floater. So smooth was his motion, that the small craft hardly rocked. He worked his way to the far end, picked up a paddle and sat down facing Konsello. "You better grab onto the gunwales when you get in and be sure to walk in the middle. These things tip easy if you don't know how. Can you swim, Konsello?"

For a moment, he thought Konsello hesitated. Then he saw the big man make a slight motion with his shoulders as if shrugging off a sudden thought, and then climb heavily over the side and down into the floater.

His weight pushed the craft deep into the water. He turned, and with perfect balance, as if he had stepped into floaters all his life, he took three smooth steps forward and sat down looking at Johnson. "I never did have to try to swim, swamper, but if this gadget should"—he paused meaningly on the word—"accidentally tip over—don't worry about me. I'll start learning right away. Let's go."

Turning around and facing front, Johnson dug his paddle, swamp-style, into the water from the bow and pulled the floater forward through a small opening between the arching tree roots. Ahead of him, the narrow path of cleared water was like a long twisting silver-green mirror, reflecting the tangled pattern of interlocked vines and branches and leaves that interlaced themselves into a solid roof over their heads, almost blocking out the dim light that did manage to filter through.

Frequently, Johnson bent low to avoid the occasional vines that hung down. Once he picked up the heavy cutting knife and with a single flick of his powerful wrist cut through a vine as thick as his ankle.

"Why don't you let me clear those things away the easy way?" asked Konsello from the stern. "Like this!" He pulled out his blaster and sent a searing beam of destruction racing ahead of the floater.

The muzzle blast of the weapon was like a thunderclap. It made Johnson's ears ring. The returning echoes rumbled deafeningly. Branches fell by the dozen.

"See how easy?" laughed Konsello and blasted another white-hot beam ahead of them.

"Put that thing away. It hurts my ears." Johnson gripped the sharp knife tightly. "I been clearing them away a long time like this. I guess I can go on doing it this way if I want to."

Konsello shrugged and holstered the blaster. "That's what's wrong with you swampers. You do everything the hard way."

Gritting his teeth, Johnson picked up the paddle again. He noticed his hands were trembling. He didn't like the feeling that was

growing steadily inside of him. Why should he try to explain to this city fellow that you had to know how to cut those branches carefully, exactly through the notch, or the stuff would sprout and plug the whole passage in again in three periods?

He gripped the paddle tighter and tried to send the floater surging ahead faster and faster. He had to get this boiling-up feeling, or whatever it was, out of himself or he felt he would explode. If this were hate, he thought, he didn't like it. He had never felt hate before. Life in the swamps didn't teach a man to hate. It took other humans to teach you that. A man couldn't hate the swamps and the animals that only tried to defend themselves against man. Their actions were normal for where they lived and ate and fought and died. Survival of the fittest. The quick and the dead. And in the swamps—the slow ones were the dead ones. And now every instinct within him was telling him to kill this man. Was this what Martha had been afraid of? Johnson tried to fight the idea down.

Suddenly the tunnel widened into a deep quiet pool. Johnson backwatered until he brought the floater to a dead stop. He studied the smooth gleaming surface carefully, and then began to pull the floater as swiftly as he could manage the long way around the edge.

"Why not make it easier and go across the middle?" put in Konsello sarcastically.

Johnson didn't take the time to reply. He was watching the quiet surface for the slightest sign of motion. He slipped the floater into a tunnel on the far side just as the waters seethed as if something big and ponderous were moving beneath the surface.

Konsello gestured with his thumb over his shoulder. "If that's one of your Swampanese friends, why don't you stop and introduce me?"

"That was no Swampanese," said Johnson grimly. "And it wasn't any friend. I'm taking you where you want to go." He bent to his paddling.

An hour later, Johnson let the floater drift to a stop in a small shallow pool. He leaned over the side and began slapping the surface of the water in an odd rhythm. He varied the quality of the sound by changing constantly from a cupped hand to the flat of his outstretched palm. He leaned back and waited.

The first warning he had of disaster was a rocking jolt of the floater and Konsello's big voice in a shout, full of alarm. He jerked around to see the city man jumping to his feet, whipping out his blaster. Johnson yelled: "Sit down, you fool! Do you want to tip us—" and as the weapon leveled in his direction, acting purely on reflex, he flung himself forward and down. Just in time to feel the hot blast sizzle over his shoulder and to hear the barking roar of the discharge.

The incoming sensations were racing across the surface of his

brain at top speed and he heard Konsello say, "That thing out there tried to climb into the boat behind you." He pointed the blaster just off the port side and pulling the trigger, began to streak repeated blasts, stinging needles of white-hot energy, down into the water.

A single glance at the green body floundering over and over in the water was enough. Billowing clouds of white steam were puffing upward like expanding mushrooms. "Konsello!" he shouted. "For your life, stop!" The floater began to rock dangerously as Johnson stumbled his way hastily aft where he grabbed Konsello's blaster arm. "Put that thing down, you fool!"

"No!" Konsello jerked with all his massive strength, and the weapon went off, roaring itself to life like a thunderbolt. The white-hot beam, crackling and ripping, tore across the floater, slicing it in two. Instantly, they were splashing in the water.

Konsello went down and came up gasping and strangling. Johnson grabbed him by the collar holding him up.

The city man knocked Johnson's supporting hand away and seized a piece of the wreckage that floated to the surface. "I don't need any help from you, swamper." He began to splash away clumsily, working his way over to the exposed tree roots.

Johnson watched him only an instant and then snatching a breath, he slipped beneath the surface looking for what he dreaded to find. He found it. A dead Swampanese.

Grim, Johnson pulled the still twitching figure over to the tree root where the city man was now resting himself. "See what you've done?" he said bitterly. "You shot a Swampanese. You killed her."

"Her?" Konsello sucked in his breath. He looked down at the figure the swamper held in his arms beneath the surface.

Johnson didn't say anything. The rage and hurt inside of him gave him a lump he couldn't swallow. The limp figure was beautiful for a Swampanese female. Slim body, head and arms and legs all covered with soft green fur. Her large eyes, so necessary to pick up the feeble light in deep water were still open, staring sightlessly upward. "Just because she breathed water in through her mouth and out through her throat gills didn't keep her from having sense and feelings in her own way. She could take a mouthful of water in her cheek pouches and come out of the water and walk around on dry land awhile just like I can take a lungful of air and swim down under the water." He moved his hand under the water and closed the staring eyes. "Somebody in swamp loved her in his own way —and you killed her." He removed his right hand and began to slap the water.

"What're you doing?"

"Talking slap-talk. I got to get somebody here to take her to whoever she belongs to."

"Now wait a minute. I killed her. It was a mistake. But if you

start calling these people around here we're liable to be in for trouble. Why don't you just let the body drift in the water and let's get out of here?"

"You killed her, Konsello."

"You and I are two humans. What does it matter? These people will all be gone soon. I have my life to think of. How do I know what they will do? I say let the body drift."

Johnson continued to slap the water. "I don't know much about city ways, Konsello. But to leave her here like this wouldn't be right. I ain't going to swim off like that when we humans did something wrong. I'm going to stay here until it's made right. If you want to leave—start swimming."

"Now wait. I'll make you a bargain. I'll let you keep your swampland. I can't get back by myself!"

"I'm staying here. The floater is gone. Your blaster is gone. Everything's gone. You start figuring, Konsello."

"Then I'll find my way back alone. I can find my way back along that channel to that machine of yours. I can figure out how it works. I'm not staying here!"

"You couldn't get back, alone, before the dark comes. Then the dark-flies would fill you full of eggs in no time at all. That's a nasty way to die, Konsello. We got to go under."

"Under?"

"Under the surface if I can slap-talk them into letting us use one of their food places. I been stuck in swamp before after the dark and those places they got down there got air in them."

There was a silence until Konsello gave a derisive snort. "You can't scare me, Johnson, with this swamp of yours. I've been in spots before. You can't afford to let anything happen to me. I put everything on record I'd go into swamp with some swamper. They can find out it was you. If I don't come back you'll get into serious trouble. That makes it your problem."

Johnson nodded his head at the pool before them. "Here's trouble now." He watched the dark-green shapes that were beginning to swirl into the pool, threshing the water into a jumbled mass of green bodies and frothy waves. A webbed hand raised above the roiling surface and slapped briefly.

"What was that?" demanded Konsello.

Johnson slapped an answer before he replied. "They just asked if the soft one had been made dead and I told them yes, and that you did it."

Konsello pulled himself up indignantly. "Now look here!" he said as another webbed hand raised up and slapped. "Find out what they intend to do. I'm a big man in certain places on Earth!"

"You're in swamp now," replied Johnson wearily. "They just said that if you killed her—the Council rules they are going to take you with them."

"Where can they take me?" The city man's voice suddenly choked. "They'll drown me." His fingers

began to twitch. He grabbed Johnson's arm. "Listen to me, Johnson. You got to do something. I never been afraid of death. I never been afraid to die when my time came if it was in a crack-up or in a fair fight. But I don't want to die down there underneath that slimy green water."

As Johnson continued to just look at him, the big man began to shake the swamper violently. "You've got to listen to me. If I don't get back you'll get into a lot of trouble. Think of Martha! Think of your kids! You can keep your farm. I'll figure out a way to dike it. But talk to them. Tell them I didn't mean to do it. Tell them—"

Johnson felt numb. His mind seemed to be working in slow motion. The man's pleas merged themselves into a meaningless jumble of sounds, dim and far away. His reason asked him: "This is what you wanted—didn't you? It was Konsello's own fault, wasn't it? Now the Swampanese will take Konsello away and deal with him in their own way. That's swamp justice, isn't it? And now the swamps and everything in it would be safe, wouldn't they?"

Like in a dream, Johnson watched one of the Swampanese swim toward him under the water and pull the limp figure of the dead female from his arms. His mind was acting as if it were remote and detached from his body with no control over its movement. Unresisting, he watched three of the green figures climb out of the water to grab Konsello and drag him, fighting and struggling, down beneath the surface. Slim green shapes swarmed around the writhing city man and took him deeper and deeper making the quiet water swirl and bubble until he could see nothing.

Finally, the waters subsided and smoothed out into the mirror-like surface that was the usual quiet of deep swamp. Konsello and the Swampanese were gone. He looked at the reflection of his own image and the half-dead interlacing trees overhead. Two minutes later he thought he heard splashing, and a faint scream from somewhere farther down the channel.

"Now," he thought, "it is done." He watched a single piece of underwater vine, ripped from the bottom, float slowly to the surface where it began to revolve lazily. Johnson focused his eyes on it. Darkness would come in three more hours. He would be a living, tortured food supply for the dark-flies if he didn't get back under cover before then. Alone now, in the time left, he could easily swim back to the skeeter and to Martha and the kids. He could make it. Then when the next light came he could go into Dry Point and explain.

But should he go off and leave Konsello like this? The city man might still be alive. Would it be right? Could he desert a man, no matter what sort of a man he was? That would be almost like murder, wouldn't it?

Like the slow turning of the floating weed, the question turned over and over inside of him. There was

a chance the Swampanese hadn't, or wouldn't, drown him right away. That scream he had heard might mean they were taking him to one of those underwater hothouses where they raised food plants that manufactured their own air. If Konsello were alive at this minute, he wouldn't be much longer unless something were done about it.

Johnson sighed. He climbed out of the water and began removing his heavy wet jumpers. No matter which way he tried to figure things out, the answer always came back the same. He had lost the swamps! There would be other Earth men to take Konsello's place. And if he did manage, somehow, to save Konsello's life—he knew the big city man would never forgive him for not putting up a struggle when the Swampanese grabbed him.

Unexpectedly, an alarming doubt stung him. Would it be possible to explain to the natives with crude slap-talk that if they ever harmed a human the plans for saving some of them in an aquarium would never be carried out? Could he explain how ruthless the human race could be when an alien culture harmed one of their own?

Stripped to his underclothes, he tied the jumpers to a tree root and marked the spot in his memory. If the Swampanese didn't turn against him for trying to interfere, and if he came out of this alive, he wanted those jumpers back. Martha had spent too many hours sewing and patching, trying to keep them neat and wearable.

Deeply and slowly, he began to inhale and exhale, charging his body with as much fresh oxygen as possible. Johnson closed his eyes to make them sensitive to the dim light of deep water while he breathed in and out for a full three minutes. Then careful to not take too big a last breath, he dived smoothly into the slimy green water.

It was cool and dark down here. The pressure began to squeeze relentlessly on his chest and eardrums as his powerful arms and legs pulled and pushed him deeper. The first wisps of underwater vegetation touched his chest and he opened his eyes as wide as possible, letting out a small bubble of air. He almost had bottom now.

Trailing the Swampanese to where they took Johnson, or his body, was going to be a difficult problem. Every ounce of swamp lore he possessed was going to be strained to the utmost during the next few minutes. Just faintly, he could pick up the torn and disturbed pieces of the vines and plants that had been displaced by threshing webbed hands and feet. He followed the trail swiftly, letting out an occasional bubble of air until his aching lungs gave him the signal he should surface for a fresh supply.

Closing his eyes, Johnson pulled up, and with eyes still closed, floated there filling his tired lungs with fresh air. Then down again, picking up the trail, swimming, surfacing, resting, breathing and down again.

The minutes dragged by. "What a terrifying ordeal," came his grim

thought, "Konsello, if he were still alive, must be suffering with the Swampanese dragging him, half-drowned, along with them under the dark waters and then taking him to the surface to let him have a quick breath and then pulling him under again."

He remembered about one time when he was a kid and had caught a bright colored fish he wanted to take home alive to put into his fish bowl and having nothing to put it in he had carried it across swamp in his bare hands, sticking its head in an occasional pool to let it breathe awhile, and then on to the next pool, and the next, until he got it home, and when his father saw him and was so angry and had taken him out into the swamp and held his head under the water until he strangled telling him that would teach him how the swamp creatures felt about their kind of breathing. The memory was still painful.

Abruptly, in the green waters before him, a round dome reared up from the bottom. Johnson knew what it was, and the trail led straight here. There was a chance Konsello was still alive. He still had swimming air so he swam down, searching for the small round opening until he found it. He pushed smoothly into the narrow dark shaft and pulled himself forward and up, watching the black water begin to lighten up with an odd purplish tint. His head broke the surface. He had been in one of these things before, but he didn't like it. The air was heavy and thick and moist with a stink that made his stomach retch.

When his eyes had adjusted themselves to the light he saw he was floating in a pool about ten meters in diameter and the curving circular walls of mud and cunningly interwoven twigs swept up into a dome over his head. Straight ahead of him was a sloping beach covered with thin leafy plants glowing with an inner purple fire. Sprawled motionless at the water edge was the body of Konsello.

Johnson swam to the beach and crawled out, rolling Konsello over on his back. Opening one of the closed eyes he saw the pupil contract and felt the figure move slightly. Then after making sure Konsello hadn't swallowed his tongue, the swamper rolled the body over on its stomach and began giving artificial respiration.

Little by little the small amount of water in the city man's lungs trickled out his mouth and in fifteen minutes he began twitching. Soon the lungs were heaving and coughing of their own accord. Finally, Johnson turned him over and pulled him up to a sitting position. The man opened his eyes.

"Johnson!" Konsello managed hoarsely. "Thank God!" His wheezy voice boomed in the constricted place. "Where am I? My lungs are on fire!" He began coughing violently, and as he seemed to gain strength he clenched his hands. "Those devils tried to drown me. I'll drain every last drop of water they got and let those devils suffer what they did to me. Where am I?"

"This is where they raise some of their food supply," said Johnson quietly.

"Food supply—eh?" Despite his weakness, he forced himself to his feet and began stumbling among the glowing plants, ripping them up with both hands. "I'll show them they can't try to drown me and get away with it—pulling me along until I'd strangle and then let me up for one tiny little breath time after time until I passed out. I don't remember them bringing me here."

"You better stop ruining their plants. You want to make them more mad when they come back?"

Konsello stopped his destruction as if he had been struck. "What do you mean—they coming back here? Let's get out of here!"

"We can't! Unless they let us. We got to stay here until the light comes. It's death in the dark."

"Now listen, swamper. If you don't get me out of this you'll suffer. When they grabbed me you didn't even try to—"

Without warning, a green thing walked up out of the water. It's webbed feet stepped surely like a man. But the arms didn't have the smooth swinging cadence of a biped used to walking on dry ground. The huge eyes were squinting against the glare of light from the plants and the cheek pouches bulged with a supply of water, the used part of which trickled fitfully out through the throat gills that showed red when they opened, letting the liquid seep into the soft green fur still dripping with moisture. The strange creature moved among the food plants inspecting the damage Konsello's rampage had caused. Then it slipped back into the water and raised a webbed hand to begin slapping the water.

When the thunderous pounding had stopped, Johnson twisted toward Konsello. "He says all the Swampanese know I am their friend. That I must go. But you have killed his young her, and he is of this place. The Council has

decided your penalty to be that you will stay here to take care of the air-breathing plants. When the Council decides it necessary, you will be taken to other food places to harvest or plant a crop as needed. That, the Council has decided."

Konsello exploded. "*Their* Council has decided? They can't do that to me! They don't know how big our civilization is. That proves what dumb, ignorant savages your friends are. You got me into this, swamper!"

"I didn't make all this trouble. And because they left the decision up to a council proves they got a civilization."

"Bah! I'll tear this place to bits with my bare hands."

"I don't think you should, Konsello," said Johnson unsmiling. "Do you realize this place is ten meters *under* the water? Do you realize this is the only bubble of air around here that is keeping you alive? Both from the water down here and the dark-flies above?" As he saw Konsello's face turn white he went on relentlessly, "Do you realize that if you did tear this place apart what would happen when all that water came pouring in here and the air started to bubble out?"

Stunned, Konsello shot a look up at the dome overhead and then down at the small pool of water which was rapidly filling with the slim green shapes of more and more Swampanese. When the full realization dawned on him of where he was, like a giant tree with its roots finally eaten away at a river's edge, he toppled over into the muddy dirt. He had covered his face with his hands, and his body began to shake and quiver uncontrollably. "Get me out of here, Johnson. I can't stand it. I'd go crazy with all that water crushing down on me." There was a mounting hysteria in his voice as it cracked on the last word.

"What's the difference? You'll still have your life. You were going to do the same thing to the Swampanese, taking them away and putting them in a little bubble of water surrounded by a lot of air. How do you think they would feel? Don't you think they might go crazy, too? That Swampanese that slap-talked to me said the Council had decided your penalty and I can't fight the entire Council!"

Konsello was obviously trying to control himself, but without success. "What am I going to do?" he asked, and his voice had that breathless quaking sound of a man just hanging desperately over the edge of a sheer drop into utter panic. "I've never been a coward. But I couldn't stand being penned up down here. You got to think of something. I didn't know the swamps were like this. I'd pay anything to get out of here."

Johnson looked down at the big man quivering at the edge of the purple glowing plants. A big man with an abject terror of being closed in by a lot of water, and then he thought of the Swampanese swimming, horror-stricken, around in a lot of tiny tanks of water surrounded by miles of air somewhere on Earth. It seemed to be a swamp justice, but yet if this man died

there would be more men coming to drain the swamps. Nobody on Earth seemed to know anything about the swamps and now they would soon be coming in droves. What if—?

The solution slid into his mind so easily and quietly that for an instant he didn't know he had it. "Konsello!" he blurted, and jerked the man to a sitting position, "how much influence you got on this project?"

"It's all mine now, so long as I keep up the payments."

"Once you sell all the herbs and the swamp is gone you won't make any more profit. Is that right?" He went on talking as rapidly as the idea formed in his brain. "If I can slap-talk the Swampanese into letting you go will you promise to dike up a big chunk of Deep Swamp for them to live in and then keep this place running sort of like an exhibition place to show all those Earth people what the swamps used to be like before they were drained? We can even fix up ways for people to come down and see places like this. They'd pay credits to see this, wouldn't they?"

Shaken as he was, Konsello's eyes narrowed. "If this were handled right it would bring in a lot of credits for a long time. A steady income. Something I've always wanted." His voice steadied. "I could even bring my wife and kids here. I could appoint you caretaker and guide and—" he broke off. "Quick, see if you can get them to agree!"

"One more thing. How about letting Mac Donavan keep his trading post just like it is? Earth people might like to buy swamp things for souvenirs." Johnson waited for the big city man's nod, then hurried over to squat at the edge of the water. He leaned over and began slapping slowly and carefully. It took a long time and when he finished, beads of perspiration were running down his face. He waited. "Slap-talk never was fancy. Don't know if I got it all across."

The hollow chamber became utterly quiet except for the muffled breathing of the two men. The air seemed close and moist. Suddenly, a webbed hand shot up and slapped violently.

"What did they say?" demanded Konsello nervously.

Johnson's shoulders drooped. "They said—NO! They're more angry than ever since I had to explain you are the one draining all the water. They don't trust you'll keep the bargain.

Konsello cracked. He jumped to his feet raving and shouting, hurling insult at the unhearing Swampanese. He began kicking and stamping among the unresisting plants.

Johnson sat motionless a long time, watching the big man's senseless fury, until deliberately he got up and walked over grabbing him by the shirt collar. He pulled Konsello's face up close, within inches of his own. "I'm going to try one thing more. I'm going to try to put up a security that you will keep your promise." He twisted the collar tight. "But if you break your

promise—I'll find you no matter where you go." He flung the man away from him and returned to his slap-talk. It was short and brief.

Even as he finished, the answer came. The hand slapped, and was gone. The waters swirled with motion and the Swampanese disappeared.

"Well?" asked Konsello.

"You got your life," he said wearily. "They'll let us stay here until the light and then help us back to the skeeter. When we get hungry we can eat some of their plants."

"But what made them change their minds so quickly? What did you offer as security I'd keep my word?"

"Martha and the two kids. I told them they knew where we lived, and Martha and the kids are alone most of the time. I told them it made sense that with their lives hanging over my head—I was bound to see you keep your promise. Those people got a lot of brains."

"Don't worry." The city man put out his hand and gripped the swamper's shoulder. "We'll both make more credits out of this exhibition idea when it is fully developed, than either of us ever made before." He smiled. "Anyhow, if you weren't such a dumb swamper, you'd know a spaceman never breaks his word."

Johnson grunted. "If you weren't such a dumb spaceman—you wouldn't be here!"

THE END.

★ ★ ★

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Brass Tacks

Woodcraft may come in handy.

Dear Campbell:

It's been a little over two years since the last missive to Brass Tacks —August 1943 issue to be exact— and the decline and recently begun resurrection of ASF has been, I fear, viewed from afar. I believe I reported in a fan magazine that I'd been carrying an old ish around in my pocket with a hand grenade at one time, which was true. Grenades can rub your bohunkus raw. ASF was the answer. Afraid I can't report any fumbling between the two at any tense moment, however.

Two years ago I was harping on the subject of world government. The "reaction" was inducive to a belief that science-fictionists were more inclined to believe in the inevitable advance of science rather than an inevitable advance of the human race. Of course that was before any United Nations' Charter. That was before a lot of things.

This latest October 1945 issue has several things which do seem provocative, though. Aside from the swing toward the escapist—this thing called "The World of A," for example—which seems a vague reminder of the old 1927 overtures, somebody had to mention that rocket research was being conducted by the wrong people. In connection with the latter, I would like to muse upon just one question with you: how greatly will the concepts of humanity be changed when the first actual expedition to another planet is realized? And *how* will concepts change? As for spacemen—interplanetary travel is more than gliding along a trajectory to intercept another planet. It implies very much more. It will be the greatest, most overpowering frontier Mankind has ever dared exploit! Spacemen may be like sailors in space, but every ounce of their effort will be directed toward reaching a goal—another planet. And when they *get* there— No, I believe you will find in the spacemen of the future an exact comparison with similar characters

of the past. They will be frontiersmen. There will be time, plenty of time, to see the coming of a commercial version of the spaceman later.

And I wonder how many changes have been wrought in Heinlein's Time Chart!

Remember the "Weapon Makers"? Odd, how a similar organization might control atomic research. Of course it would be best that humanity never know—not for a while, at least. And care would have to be exercised to its utmost. There might be members that would like "power" in a more technological sense. And there would have to be someone to eliminate such members. But such an organization could go far with atomic power. Much farther than the world is prepared to accept.

It would be nice, too, for a science-fictionist to know about, because if there is an atomic war there'll be some of us who will brush up on our knowledge of woodsmanship. And it would be nice to know where to find this atomics clique, after it was all over—to start all over again, to reconstruct.

On the other hand, an Atomics Foundation would be just the thing for interplanetary travel!—Joe Gibson.

The country dweller will never be at the mercy of atomic bombs—explosives are adequate, and much cheaper. Only cities are targets worth using atomic bombs against.

Dear Mr. Campbell:

The November issue of Astounding was one of the best on record—V. E. and Foundation stories and the rest all good stuff.

One of the best features of the issue was your editorial—Atomic Age—which is one of the sanest, clearest things that has been said about atomic power to date. It shows that science-fiction has a definite value in that you, the editor of a science-fiction magazine, can talk more sanely on the subject than Winston Churchill, President Truman or any other person who has attempted to discuss it. You have the sincerest thanks of this and every stfan.

As an stfan I would like to offer my comment on the subject for what it is worth.

To start with, it is easy to see where the pessimists get the idea that the atomic bomb is "the end of the world, et cetera, et cetera." Actually, the possibility of the chain reaction is not to be ignored, especially if other atoms besides U-235, U-238 and Plutonium are experimented with. My own personal opinion is that the atomic power does not mean the end of the world. I have no scientific or logical reason for saying this. It is just that I think that those frail little creatures, the human race, are virtually indestructible.

As far as our present civilization being dead, I think you are right there too as far as you go, but as you hinted in your editorial, if a defense against atomic weapons is found, cities will still be possible.

Not only that, but cities will become even more the center of human life, for they will be the only safe places to live, since they can be protected and defended while country dwellers will be at the mercy of the various atomic weapons. It is probable that, if this happened, synthetic food would be perfected under the press of necessity and, once this was accomplished, the world would resolve itself into a civilization of great cities dotted sparsely among the countries with great stretches of uninhabited country between.

The atomic weapon could be the "Doomsday Bomb" but it also could be the greatest asset to the world that Earth has ever known. Not only in the industrial and commercial sense, but in the sense that it would bring the nations together by the primal force of self-preservation. For once the first Atomic War has been fought, the world will become so sobered that *everything*—every political wish, every social dislike, every religious prejudice will be crushed by the awful knowledge that THERE MUST BE PEACE.

I think that a Parliament of Nations with all the powers, facilities and working that the name implies, is the solution. It would actually be the World State of science-fiction legend, but it would be workable. Firstly, because it would have all nations with an actual voice and a fair chance to voice their views in the World Parliament and, secondly, because it would have a backing of force in the sense that any nation or group of nations who started aggression contrary to the will of the majority in the World Parliament would have the awful knowledge that THE REST OF THE WORLD WAS MARCHING AGAINST THEM. Peace *would be kept* because each elected representative from each nation would know that failure would mean another Atomic War and possibly the end of the world.

I do not think this will happen until the world has been subjected to the First Atomic War. It will not take place until the world has been rocked, sickened, shocked, disgusted and terrified by the ferocity of it. Until it has seen great cities wiped off the face of the Earth like specks of dust off a mirror. Until all humanity has caught a glimpse of the eternal terror of final destruction. Then and only then will the World Parliament be possible, for such is human nature that it must be rocked to its very core before it is affected.

Looking back over this letter I find it sounds a bit egotistical, but in the immortal words of one fan letter hack, "What fan isn't?"—R. R. Anger, 520 Highland Avenue, Ottawa, Ontario, Canada.

On the flight of V-2's.

Dear Mr. Campbell:

I recently wrote you concerning the reasons for the irregular track of the V-2 rocket bomb. I have found what I believe to be the true explanation of the phenomenon.

Ideally the V-2 would fly so that the long axis always coincided with

the line of flight but practically this ideal is seldom, if ever, attained. There is always likely to be a certain deviation. The rocket then behaves like an airfoil, one of unusual design to be sure, but an airfoil nevertheless. As a result two forces come into play, one tending to lift it out of its path and the other tending to cause rotation about its center of gravity and bring its long axis back into coincidence with its line of flight. Inertia carries it beyond this condition and the same forces again operate but in the opposite direction. The result is that the rocket swings back and forth about its center of gravity, something like a fish swimming through water. Superimposed on this is a tendency of the whole rocket to move from side to side of its trajectory. Since the section of the rocket is circular these motions are vertical, horizontal or anything in between. An observer some distance away will see the vertical variations, but not the lateral ones. Those in some intermediate plane will appear to have less than this actual magnitude. It is most unlikely that all, or even most of the swinging, will be in one plane so that a combination of these effects will result in an irregular track as seen by a distant observer.

The fins exert a dampening effect which becomes more effective as the velocity increases. Thus the calculated period of oscillation is 1.15 seconds at fifty thousand feet and 350 seconds at three hundred thousand feet. I am uncertain of the period on the way up below fifty thousand feet, but as the rocket is slowed by air resistance on the way down, oscillation again sets in with a period of 0.85 second at fifty thousand feet and 0.36 second at impact. Apparently oscillation is somewhat more rapid on the way down than on the way up.

Calculations have been made of the effectiveness of the vanes in the jet stream and the tabs at the outer corners of the fins. The former are the most effective and neither is very effective after the jet is turned off. Neither is capable of making rapid changes in the direction of the rocket. The minimum radius of curvature that they can produce is some twenty-two thousand feet. It is obvious, therefore, that the control gyros have relatively little to do with oscillation about the average path of the rocket. —John Buddhue, 99 South Raymond Avenue, Pasadena 2, California.

Then too, a man can think very logically and clearly, in a most furious hurry, when he's scared.

Dear Mr. Campbell:

On reading Emmett McDowell's novelette "Veiled Island" in the January Astounding, I was struck by the thought that here was a very clear-cut example of a thesis that has been all too common in science-fiction; the thesis that "emotion" is a handicap to any really "intelligent" race, and that "homo superior," "superman"—or whatever you choose to call him

—will not be troubled by such disturbances.

Actually, from a psychological viewpoint, such a notion is probably sheer nonsense. If I may be granted the space, I should like to point out certain reasons why this is so.

In the first place, it has been shown empirically that emotions have a disruptive function. They serve to break down the normal routine pattern of activity, and thus prepare the organism for actions of a different or "emergency" nature. It is easy to see that some such disruptive function is necessary for survival. Thus, if I am reading quietly in my room and a madman rushes in, firing a pistol, my chances of living to a ripe old age are very sharply decreased if my routine activity—reading—is not promptly broken off, and some emergency action substituted. Being, I hope, normal in such respects, the vital disruption would be performed automatically by the emotion of fear. Also, as servicemen know very well, an absolutely fearless individual is not only not going to last very long in action himself, but will almost certainly constitute a distinct menace to his companions through the foolhardy nature of his "fearless" reactions.

So much for what can be observed as a matter of common experience. From a more technical and psysiological angle, it is known that emotional responses involve increased activity of that branch of the nervous organization called the sympathetic nervous system, plus a consequent stimulation of the adrenal glands. This causes a rise in pulse rate and blood pressure; stops digestion; increases the amount of sugar in the blood available as fuel; makes the blood clot more readily, etc., etcetera—most of which reactions are, in general, helpful and even necessary to an organism struggling for its existence.

The foregoing is by no means a complete account of the nature of emotion; the role of the thalamus as a center of emotional activity has been neglected, as has been that of the cortex in the control of emotions, and the corticalthalamic interactions and integrations which appear to be of vital necessity in determining the adequacy of an emotional response to a complex situation. But enough has been said, I think, to demonstrate that emotion is not a handicap in and of itself, but is rather a definite survival factor. The difficulties which civilized man experiences with regard to his emotions seem to lie, not in the emotional state, but in the fact that he has not as yet learned to transform his primitive responses into responses more adequate to the complexity of a highly technical civilization.

In closing, it would seem that if we wish to postulate a "superman" without emotion, we should supply him with some alternative psychological factor to perform the necessary functions of emotion. In all probability, McDowell's emotionless "homo superior" could

not have survived long enough even to advance to a stage of barbarism.—A. A. Smith, Queen's University, Kingston, Ontario, Canada.

ON THE DECEMBER, 1945 ASTOUNDING S-F

1. "The Mule" (conclusion) . . An stf classic by a great stf author. To say that it is Asimov's best work is to pay it g r e a t e s t honor—when one remembers such stories as Victory Unintentional. I do not know whether or not the test of a story is memory, but of one thing I am sure. I will never forget Magnifico the jester.
2. "Beggars in Velvet" . . . Another of Lewis Padgett's masterpieces of characterization. Padgett has an almost uncanny gift for expressing "thoughts"—and his characterization in "Three Blind Mice," "The Lion and the Unicorn," "Camouflage" and "Beggars in Velvet" are hard to equal in stf fiction.
3. "Trouble Times Two" . Didn't understand it very well. I didn't get what was obviously the "punch" of the story, contained in that picture at the end of the yarn. What was the idea anyhow? Did the physicist become the engineer when he tackled the practical problem or somethin'? Why "Resignation not accepted," hnh? Oh well, it's the only stf yarn that ever stumped me.
4. "Orders" . . . There are some things even an egotistical stf fan-letter hack would not do. One of these would be to criticize the last Malcolm Jameson story he or anyone else will ever read. I salute Malcolm Jameson. He fought as great a fight during his lifetime as did any of his characters. May he and Commander Bullard be talking over old times in that rosy Valhalla where they, like all great fighters, must be.

I will close by saying, as you doubtless know, you are currently publishing the best science-fiction publication in the world and have been for some time.—R. R. Anger, 520 Highland Avenue, Ottawa, Ontario, Canada.

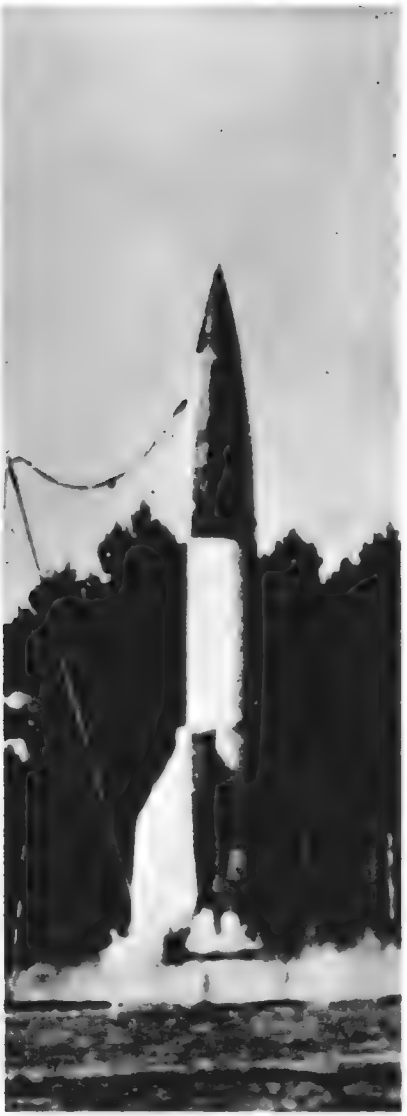
Bats can be heard to squeak—but the 60,000 cycle squeaks—the really important part of their squeaking—is inaudible. Same with Television. Some of it can be heard, but only the small fraction between 50 and 15,000 cycles. The part from 15,000 to 5,000,000 cycles is lost.

Dear Mr. Campbell:

There is a fallacy in your statement at the head of Mr. Croutch's letter in the December issue. The statement is perfectly true in itself, but the article mentioned by Mr. Croutch says that television signals may be changed to audible sounds through a receiver and speaker. If this is so, there is no reason why those sounds cannot be

(*Continued on page 170*)

Spaceship
TAKE-OFF



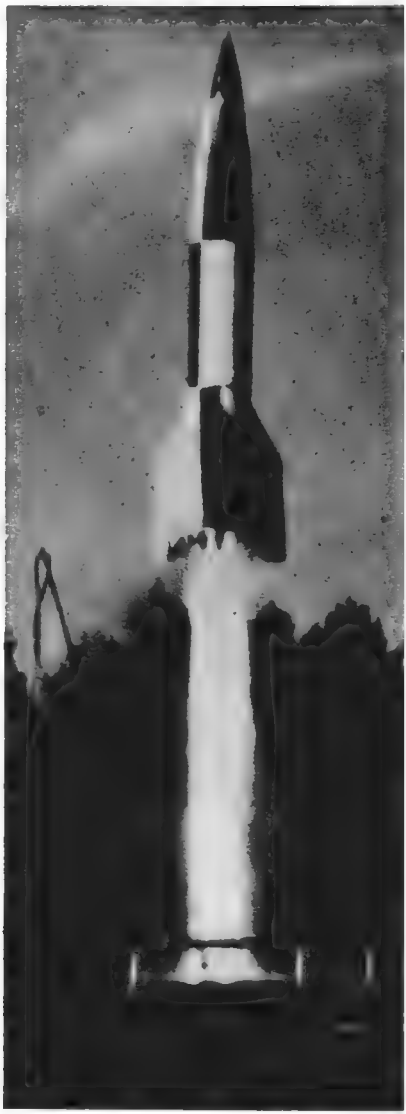
Understandably, the British Government had considerable interest in the design, manufacture and performance facts and figures regarding the German rocket cargo ship. The British knew a *great* deal about what it did when it came down. They even knew quite a bit about how it behaved in flight. Radar—particularly the giant long-range microwave early warning set that worked from the southeast of England—had been able to track the take-off flight, and entire trip of the rockets on their way up, over, and down again. The British-American knowledge of the flight characteristics of the rockets may well have been better than that of the Germans; our radar equipment was markedly more accurate, and had markedly greater range.

The trouble with all this knowledge of the flight of the V-2 was that while we could send our radar pulses out to hit and return with the desired information, there was no weapon in the Allied armory capable of getting where a V-2 was when the V-2 got there. At the moment the last of the fuel was exhausted, the V-2 had a velocity very near one mile a second; when it was dropping onto England, the velocity had been

decreased—by air resistance during the passage—to about half a mile a second. That was still far too fast for any antiaircraft shell.

But the British very much wanted to now what the V-2 was like on take-off. During the defeat of Germany, when Anglo-American armored columns were slicing across Germany faster than German communications could report their progress, a train loaded with V-2's was captured—complete with detailed operation instruction manuals. After the job of conquering Germany was finished, Allied research teams set up and launched a V-2, recording the entire process on movie film. The accompanying photographs are stills taken from that film. If you've seen the film in newsreel form, you saw that the giant rocket rises, at the start, with a strange deliberation, as steady and straight as an elevator. It must be an incredible scene; the giant and massive machine, hissing furiously, suspended in midair and rising steadily on the jetting flame.

The third photograph, on page 101, shows clearly the remarkable degree to which the jet-design directs all the exhaust gases in one straight, tight column, with practically no lost—sidewise—motion.



HEADACHES FOR RADARS

No weapon which depends on sensitivity, skill and finesse for its operation is immune to counter-attack; radar, as the ultimate in sensitivity, skill and finesse, is, inevitably, wide open to counter-

measures—and the Allies, who had the best radar equipment, had the best countermeasures. Actually, the indications are that radar is a one-war weapon, a weapon of surprise, where "surprise" is interpreted to cover a period of months or a few years. Actually, the Germans succeeded in countering our early radar sets very quickly; the Allied radar was able to continue as a highly effective weapon only because the continuous development of new techniques, new wavebands, proceeded faster than the German laboratories could follow. To quote Kipling:

"They copied all they could follow,
"But they couldn't follow my mind—
"So I left 'em, sweatin' and stealin',
"A year and a half behind."

In radar countermeasures, the American developments were enormously advanced. First, simplest, and one of the most effective was the use of aluminum foil strips—the material shown on page 103. Radar operates by transmitting a sharp puise, and then waiting in complete silence for the echo, and very accurately timing that echo. The strength of the echo indicates, normally, how large an object was struck.

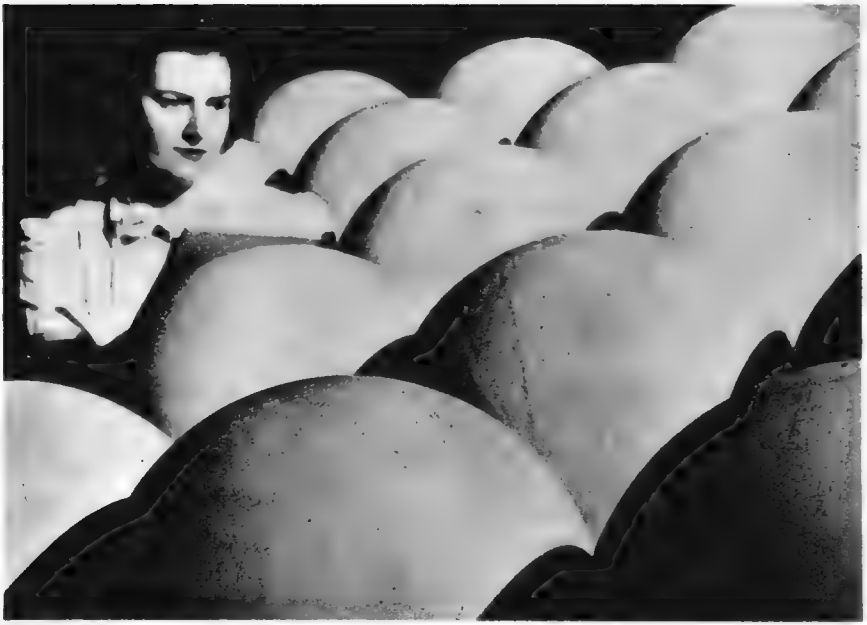
But radar frequencies are astonishingly like sound frequencies. The wave lengths are about the same, and the waves can set up semimechanical resonances in metal. Tuning is done with resonant cavities; wave lengths can be measured directly with callipers by setting up a conductor and varying its length until electrical resonance occurs, and then simply measuring that length. Aluminum foil, cut to that determined length, will resonate—"ring"—when struck by the radar wave, for a considerable time—on radar's time-scale—after being struck, and return an "echo" that looks millions of times stronger than the echo from such a flimsy thing has any normal right to. One piece of aluminum foil can appear, on a radar scope, as large as a whole nonresonating bomber. That makes for confusion. On page 104 is a picture of that confusion; at the left, a German radar scope with a plane spotted; at right the same scope after the plane has dropped a few bunches of aluminum foil. The photographs were taken from a German training film; the Nazis didn't like the foil at all.

On page 102 is a picture of a far more complex method of balling up the works; a radar jamming transmitter. It sends pulses too. It is very carefully tuned to the enemy radar frequency, and to the enemy radar's pulse-rate. But the pulses it sends are, of course, quite meaningless, and when a collection of jammer-equipped planes flies overhead, the data furnished by the radar below are as intelligible as the gibberings of a lunatic.

America's final triumph, though, can't be shown as yet. It was known as "Tuba," technically as a "resnatron," and generated a stupendous and stupefying flood of radar energy—sheer, terrific noise. Two hundred miles away its blatting blasts of radar noise

completely bollixed the Luftwaffe's night-fighter radar. It was like trying to hear the echo from the cliff across the way while a man on the cliff delivered a continuous, very loud Bronx cheer. Tuba, in England, defeated German radar over Germany.

Though probably useless henceforth as a prime war weapon, the microwave techniques developed for radar have new uses. Page 105 shows the "lamp" and reflectors for microwave spotlights. These microwave projectors throw sharp beams that can be used for commercial communication transmission, doing away with the need for wire links in cross-country communication networks. China, without telephone links today, will probably install such service, with the result that, ten years hence, China's telephone system may be more modern than America's!



Radar, as everyone knows, was purely an electronic problem. Sadly, it wasn't—not by a long, long way. It was also an aerodynamic, plastic, metallurgical, machine-tool, and, in fact, general industrial problem.

Above are a collection of radomes—domes for radar antennas. A radar projector, by the nature of things, involves a parabolic reflector, or something equivalent; in no case is it even remotely conducive to streamline form. If carried on a plane, it has to be enclosed in a streamlined shell, or dome—like these.

But then comes the headache. The dome must be perfectly transparent—to radar—and must not refract the radar beams appreciably. Oh, yes; radar beams can be refracted—Hertz demonstrated that. The dome obviously can't be metal, so it must be plastic.

But not just any plastic. To radar, standard bakelite is like heavily darkened glass is to light. Polystyrene is the ideal plastic for high-frequency radar—it's almost perfectly transparent. Unfortunately it isn't too strong, and, worse, melts at a low temperature—about like a hard wax. With a really fast modern plane, air-friction, and air-compression causes very severe heating, more than enough to melt polystyrene; enough to damage even resistant phenol-formaldehyde plastics in certain locations on the ultrafast planes. Westinghouse made these; the composition is not revealed!

The modern roc lays a super-modern egg, the radio-operated controllable bomb. The "high angle" refers to the fact that, since this bomb does not have wings, it has a gliding angle somewhat steeper than that of the traditional kitchen sink. The radio controls can't keep it from falling, but by tilting the angle of the airfoil section band around the bomb, the direction of the fall can be controlled to a considerable extent.

In high-altitude bombing, it is possible to make proper allowance for plane speed, direction and altitude, the plane's air speed vs. ground speed, the rate of fall of the bomb, and the effects of gravity and air resistance. But you cannot take into account all the varying lower-level winds, because they are necessarily unknowns. Hitting a pin-point target, such as a railroad bridge, from high altitude becomes a matter of chance.

The ROC's egg, on the other hand, can set up its own local "winds" of sufficient strength to blow it back onto the course, and assure a dead-center hit.

The Nazis tried to develop something of the sort, but their dirigible bomb was controlled by electric signals carried by a couple of miles of fine wire that the dropping bomb spun out behind it as it left the plane, like a spider dropping on her thread.

THE BETATRON

Just before the United States got into the war, Astounding reported the invention of the betatron. It was mentioned in one story—"Recoil," by George O. Smith—but the betatron, like atomic fission, has been under wraps since. This is one of the first pictures released.

Built by the General Electric laboratories, the betatron is a trick super-transformer. Theoretically, a transformer can convert any voltage of alternating current into any desired voltage—110 volt household power to 110,000,000 volt power, for instance. The trouble with this theory is that the electrostatic stress represented by 100,000,000 volts is more than any insulation can endure. Actually, 2,000,000 volts is about the limit for an ordinary transformer system.

The betatron is, nevertheless, a transformer which produces 100,000,000 volts—or to be more accurate, the equivalent thereof. It produces a kinetic energy in electrons equivalent to that the electrons would accumulate in falling through a potential of 100,000,000 volts.

The huge magnetic core of the betatron resembles that of a cyclotron; the big magnetic coils used resemble those of the cyclotron. But there the resemblance ceases;

the magnetic core of the cyclotron is actually made of great, solid slabs of soft iron. The betatron's core is made up of laminations of transformer iron; it is an alternating current, rather than a direct current magnetic device.

The cyclotron uses a magnetic field to hold the fast-moving ions under control; the energy is fed into the ions from a 10 megacycle, 100,000 watt short-wave radio transmitter. In the betatron the magnetic field controls the motion of the electrons, *but the magnetic field is itself the source of their energy.*

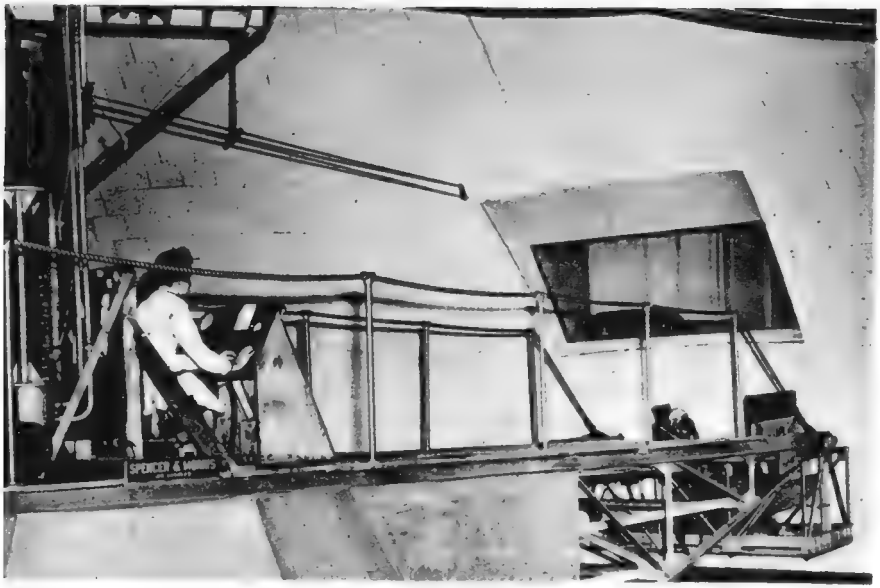
In essence, the betatron is a transformer, the secondary winding of which consists of a vacuum tube—a doughnut shaped vacuum tube around the core of the transformer. Electrons are shot into this tube from a standard electron-emitting filament at the instant that a bank of powerful, high-capacity condensers is discharged into the big magnetic coils. The discharge of the stored energy in the condensers builds up the magnetic field in the coils and the core. The electrons which have been shot into the vacuum-tube doughnut act precisely as the electrons in a copper wire wound around the core would; the increasing magnetic field accelerates them. At the same time it accelerates them, the magnetic field forces them to take curved trajectories—to go around the core in a circular orbit instead of taking off on a tangent.

The rising magnetic field constantly accelerates them, which tends to make them go in larger orbits because of higher speed. But simultaneously, the increasing strength of the magnetic field tends to force them into narrower orbits. The two effects are mathematically equal and opposite; the electrons remain in a circular orbit.

It takes approximately 1/240th of a second for the condenser bank to discharge into the magnet coils. In that time, the electrons make about 250,000 revolutions around the core, and are accelerated to a speed equivalent to 100,000,000 volts. They are traveling at speed so close to the speed of light that they are nearly 1/10th as massive as protons—about two hundred times heavier than at the start.

At the instant the condensers have drained into the coils, a pulse of current applied to an auxiliary coil causes the swarm of electrons to deflect and strike a tungsten target which they had missed previously. Xrays are produced—but Xrays vastly more penetrating than the hardest gamma rays produced by radioactive elements. Only the fission of uranium can equal in violence the smashing blow these super-accelerated electrons deliver.

The enormously high energy level of the Xrays given off has the interesting effect of causing nearly all the energy of the quanta to be absorbed in creating electrons and positrons out of empty interatomic space, rather than simply being absorbed as heat in the blocking material.



G-STRING TO ANTI-G-SUIT

The one-man merry-go-round above is guaranteed to cause a sensation in anybody, including the most hardened roller-coaster addict. If nothing less suits, it will produce blackout—in fact it was specifically designed to do just that, duplicating in its full unpleasantness the effect of a 9-G pull-out of a dive bomber. Designing a machine to produce the effect isn't anywhere near as simple as it might seem. Getting the necessary 9-G is easy—the long arm with the gimbal-swung chair at the end takes care of that. But the essential feature of an actual 9-G pull-out is that it doesn't last very long. The trick in designing a machine to test the phenomena involved was to make one that would build up the 9-G effect in a matter of a very few seconds, and then back off the 9-G to a more reasonable level in an equally small number of seconds.

The purpose? To find out how to make the anti-G suit.

Blood may be thicker than water, but it has the same habit of running downhill when gravity, or other acceleration, pulls. It runs from the brain and eyes, and heart, where it's needed, to the feet, ankles and legs where it is not needed, and not wanted. The blood vessels in the brain and eyes collapse, the blood volume available for the heart to pump practically vanishes, while the blood vessels of feet and legs and lower abdomen become vastly and dangerously distended.

The anti-G suit was rigged to overcome that. The Germans tried using a suit consisting of an inner

waterproof rubber garment and an outer, inelastic garment, the space between being filled with water. Under acceleration, the water tried to go the same way blood did, thus crowding the space in the inelastic outer suit and forcing the blood back where it belonged. Too clumsy — pilots wouldn't wear them.

The University of Southern California helped develop this suit. Inflatable air-packs supply counter-pressure in legs and abdomen, and force the blood back toward the head. The amount of squeeze applied by the air-bags is controlled by a small valve regulated by an accelerometer. More Gs, more air.

The suit works—and is comfortable in between dives.

Unapproachable

by GEORGE O. SMITH

A fuller explanation of the ruggedest radio set—and ruggedest isolationist!—ever built. Of all things the German soldier dreaded, American artillery firing the proximity-fused shell was the best loathed. The Luftwaffe pilot agreed with him. The designer of the V-1 agreed with him. The Jap kamikaze pilot, on the other hand, was going to die anyway—

Illustrated by G. O. Smith

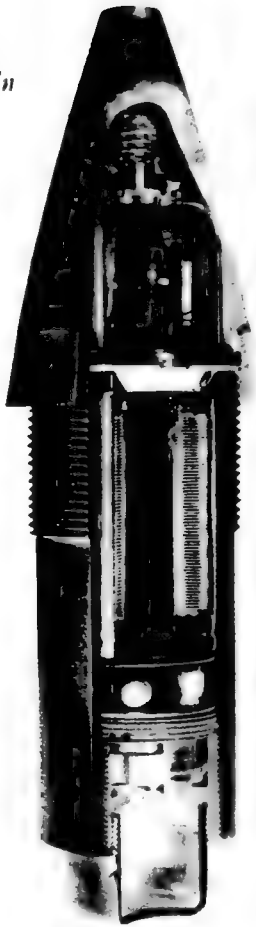
The Radio Proximity Fuse is a type of electronic brain. It is incapable of free thought, but it is possessed of some of the characteristics of the brain. It has a sensory system, and a single instinct. A stimulus entering the sensory channel of the proximity fuse sets off the reaction. The instinct is toward isolation and any sensory impulse indicates a violation of that instinct. The immediate reaction is for self-destruction and the fact that everything in its neighborhood suffers is of no interest to the supreme introverted mentality of this rudimentary brain.

It was born of necessity, like most inventions. It came to answer some baffling problems in antiaircraft gunnery. Were it not for the problems, the Radio Proximity Fuse would never have been born.

Back in World War I, the antiaircraft fire was affectionately called "Archie" and Archie spoke frequently but without authority. A perusal of the air-war books of that period will show the pitifully small returns obtained from the very liberal expenditure of powder and lead. The pilots of that period were often annoyed at Archie because the air was filled with the black bursts that impeded the seeing and spotting of artillery shells, bombing missions, and ground-strafing. When the airplanes appeared, the ground became dotted with upended artillery pieces. They ranged by guess and by estimate and by bracketing. Bracketing is a fine way to aim artillery providing the target remains in the neighborhood long enough to be bracketed. Archie needed something.

In the intervening years, Archie grew up. Planes increased their speed by more than twice, but antiaircraft fire assumed maturity and

The proximity fuse, ready to assemble in a shell, and sectioned.



the appellation was lost. Radar ranged the planes. Gun-directors calculated eight or nine factors, set the time fuses, and fired the guns. The gun crews had only to keep sights on the plane and feed the guns. The mechanico-electrical computers and directors did the rest.

But the *Prince of Wales* and the *Repulse* were the victims of an air attack.

Grown up or not, Archie needed something.

The guns were properly directed, properly fired, and properly handled. The fuses were the best that modern man could devise.

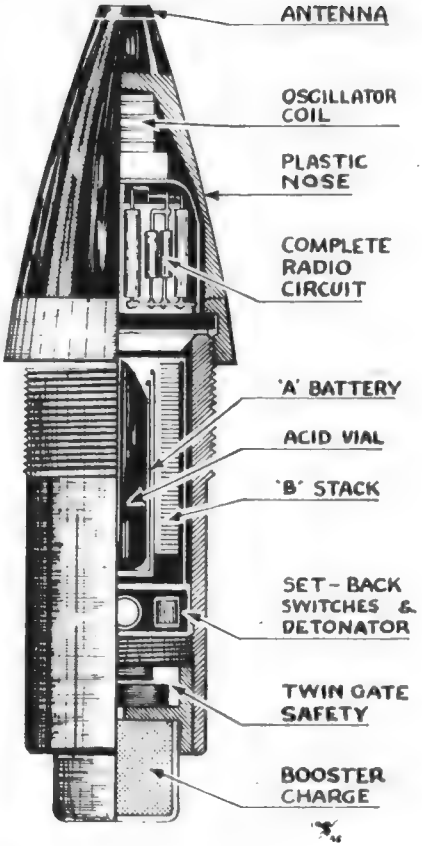
The trouble? The trouble lies in *time*. To evaluate the importance of time, consider the following.

An enemy dive bomber is detected at 12,000 feet. The dive bomber is starting his run at you, diving upon your ship at 400 miles per hour. He will loose his bomb at you at 1200 feet altitude. You have a total of 18 seconds to destroy him. The type of gun effective against such will permit, perhaps, six or seven rounds in 18 seconds.

The average velocity of such anti-aircraft shells is about 1,800 feet per second. To be effective, they must burst within 200 feet of the plane. Therefore, if everything is set correctly, the time-fuse must go off within one-tenth of a second of the precise time. At the end of 5.0 seconds, plane and shell will meet at 9000 feet altitude. That is the first round, fired upon detection. The next round, fired three seconds after the first, is in the air before the first shell arrives, but it takes 4.25 seconds and meets the plane at 7650 feet altitude. The third takes 3.5 seconds and meets the plane at 6300 feet. The fourth takes 2.75 seconds and meets at 4950 feet. Fifth: 2.0 seconds; 3600 feet. Sixth: 1.25 seconds; 2250 feet. Seventh: well, since there is a three-second interval between rounds, the plane has come and gone by a matter of 600 feet at firing instant.

In a matter of fuse-timing percentages of error, respectively, you are permitted the following: 1, 0.20%; 2, 0.22%; 3, 0.29%; 4, 0.36%; 5, 0.5%; 6, 0.8%.

These figures seem tight when mentioned in terms of mechanical items. But fuses are timed by the burning-rate of a powder train.



The working parts of the proximity fuse.

Despite accurate manufacturing controls, despite batch-sampling, there is nothing that says that an ounce of powder from one batch will be identical to an ounce of test sample. That is omitting the error introduced by the temperature of the shell, which may be high because it was in the ready-box on a sun-drenched deck or fairly low because it came from a magazine below deck.

But those figures are fuse-timing

tolerances, not fuse-setting tolerances. Setting a fuse to 5.0 seconds means setting the calibration ring to one point, about one-tenth of the total range possible. So that 0.2% time-tolerance means 0.02% setting error permitted! Design me a machine to set a calibration ring to within 0.02% of precision. It is done, but it slows up the fire, for machine-setting means first setting the machine. Then the shell is inserted in the machine and set. The shell is removed from the machine and inserted in the breech of the gun. The propellent cartridge is added; the breech is closed, and the gun is fired. Meanwhile the next shell is being prepared.

This is done while the dive bomber is (1) preparing to deliver a bomb, and (2) while the dive bomber is delivering a barrage of machine-gun fire to harass the gun crew.

Meanwhile, unpredictable variations are creeping in. The propelling charge must be right on the nose for amount and temperature and controlled factors. The variations here are the same as for the powder train in the fuse. The ultimate velocity of a shell is based upon this, and upon the following factors: the projectile's weight; the number of previous rounds from the gun barrel; the firing rate of gun barrel, since thirty rounds per minute makes a greater change than thirty rounds in three minutes; the "Yaw" of the shell; the internal heat of the barrel; the perfection of the rifling band—both before and after firing. Before will determine the amount of blow-by or wasted propelling power; afterwards will set up turbulence and affect the velocity.

Grown up to scientific stature, Archie still needed something. Internal electronic timing might eliminate the fuse dispersion, as would an electronic receiver pulsed after a stated interval by the gun director. The latter would permit the gun crew to just feed away and forget the fuse-setting, but this would not eliminate the gun dispersion factors and would introduce another annoying item. Take four guns firing at four planes—how do you keep pulser number three from touching off shells from gun number one? Echo answers "You can't."

Archie needed full electronic control, and then he joined in with the rest of this civilization. He lost his name and became the Proximity Fuse.

When Archie became a full-fledged member of the technological society, he arrived carrying a complete portable radio equipment. This radio gear is neatly made, packaged in a streamlined steel case, and designed to withstand the rough handling which is a result of delivering them to the customer at 1,800 feet per second. If the customer does not appreciate delivery, he is in no position to send it back. If, perchance, the item does not work, it is immediately replaced with a series of others. It is the intent of the delivering agency that the ultimate customer be unsatisfied.

Archie's radio equipment is sim-

ple. It consists of an oscillating detector, a resistance coupled amplifier, and an output stage. This is battery-powered.

The entire circuit is based on several well known electronic principles. The oscillating detector is similar to those used in the early heyday of radio, when many cities observed a "silent night" for local stations for the benefit of radio experimenters. These fellows used to sit up to all hours of the night logging out-of-town stations on a one-tube "blooper." The name is not affectionate.

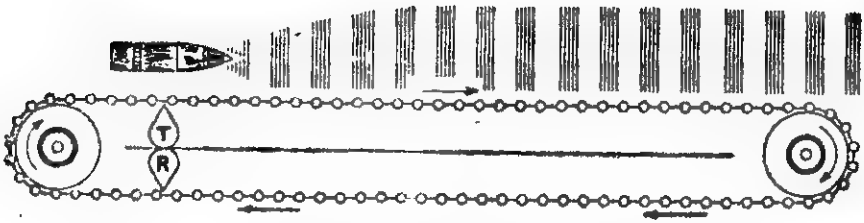
The oscillating detector, or "blooper" is an efficient circuit but it is outlawed because of external interference. When working smoothly and efficiently for the listener, it is radiating a signal of its own. This causes squeals, whistles, and pig-calls in the other fellow's receiver. Conversely, his is also fouling up your own. For blocks around the neighborhood, the interference was terrific, and therefore the appellation: *Blooper.* The oscillating detector is, of course, in synchronism with itself, and therefore does not cause any interference to its own operation. The circuit, being in synchronism with itself, actually reinforces its own input by re-radiation or regeneration. This self-reinforcement makes it capable of taking a very weak signal and building it up to audible proportions. But another such detector in the neighborhood if not in perfect tune by about one part in 100,000 parts, will produce beat notes. Beat notes are the same as the effect produced by striking two adjoining notes on a piano; in radio, the frequencies are so much higher than a whistle occurs instead of a wavering volume, and the tone of the whistle depends upon the frequency difference between the two signals.

The Proximity Fuse uses this principle. Instead of another oscillator, however, the frequency difference or beat note is produced by the velocity of the shell in flight. The radio wave is radiated from the antenna in the nose of the shell. The wave goes out, reflects from some offending object in the air, and returns to the antenna. Since the antenna is connected to the oscillating detector, the radiated signal is mixed with the reflected signal. The frequency difference comes from the "Doppler" effect.

The drawing shows the shell in flight, radiating a series of waves. The bands flowing out from the nose indicate the maxima and minima of the radio wave. Below the shell is a chain and sprocket system, running at a constant velocity. The speed of the chain is analogous to the speed of radio waves, or 186,000 miles per second. The distance between links corresponds to the wave length of a radio wave.

Note that the velocity is constant, and so is the wave length. Frequency, obviously, will be a function of velocity and wave length; a matter of the number of links or waves that pass a given point in one second when running at a constant velocity.

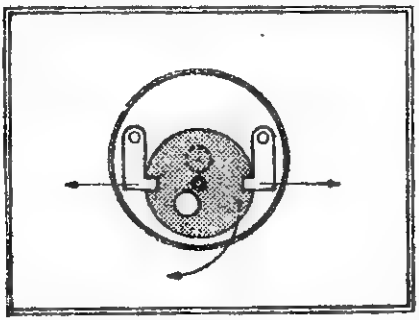
If the shell is standing still, the number of links touched by the



The Doppler effect makes the effective frequency of the returned wave different from the frequency of the oscillator in the shell. The slight difference sets up an audio-frequency note which is amplified and then fires the shell.

transmitting pick T is equal to the number of links touched by the receiving pick R. No frequency difference occurs.

If the shell moves forward from left to right, it is the same as moving the pick system at a corresponding speed. The transmitter pick T will touch less links per second since each link must move one "wave length" plus the distance moved by the pick during the interval. The receiving pick will touch more links since each link need move one wave length minus the distance covered by the pick. The frequency difference varies with velocity. At zero velocity, zero frequency difference. When the pick is moving at the chain velocity, the frequency is doubled.



Twin Gate Safety showing forces involved.

The oscillating detector takes its own frequency, adds the frequency of the reflected wave, compares the difference, eliminates the high frequencies and delivers the difference-frequency to the amplifier circuit as a beat note. As the shell approaches the target, the intensity of the beat note increases—not the frequency—because of the radiation increase with decreasing distance. This is the same factor that causes the light intensity to increase when you bring the floor lamp over closer to your reading chair.

The resulting beat note is amplified in an efficient little amplifier which is designed to pass only those frequencies that result from the shell's approach to a target. The output of the amplifier is used to control the grid voltage of a thyratron.

A thyratron is a type of electronic switch. It is similar to a radio tube in construction but is filled with gas instead of a hard vacuum. The pressure of the gas prevents the flow of current until certain conditions within the tube are satisfied. Nothing happens, then, until the critical moment.

The controlling element of a thyratron is a grid. So long as the voltage at the grid is negative with respect to the cathode, the nonconducting state of the thyratron is maintained. As the shell approaches the target, however, the voltage on the grid rises and falls with each peak of the amplified beat note. At a certain distance from the target, the beat note signal peaks will exceed the critical grid voltage. This is called the "threshold of operation" when discussing thyratrons. At the instant that the grid voltage exceeds the threshold level, the gas in the tube ionizes like a neon sign, and current is conducted through the tube.

The thyratron plate current also passes through a dynamite detonator of the type used in magneto blasting. The passage of current explodes the detonator.

The dynamite cap is housed in a bakelite block which also contains two mercury switches. Both switches short the dynamite cap; a safety measure. Upon setback, the vertical switch opens and upon the spin of the shell, the horizontal switch opens. The circuit is now free and the dynamite cap will explode when the thyratron conducts its current.

As a further safety measure, the dynamite cap is separated from the booster charge by a twin gate safety that operates only upon spin. The centrifugal force resulting from spin swings two latches aside and the rotary gate revolves until the holes are in line. There are two such gates built into a single unit, swinging in toward a central hole from opposing sides. When armed, all three holes line up, providing a small tunnel from the dynamite cap to the booster charge.

When all of this happens, the booster charge detonates the high explosive contained in the shell itself. The portable radio has been delivered and the customer is unhappy. And there are no maintenance manuals telling how to repair one of Archie's radio sets.

To power the circuit and to fire the dynamite cap a wet cell battery is provided. The filaments of the tubes are heated by an "A" cell consisting of a long cylinder of zinc and carbon-coated metal. The "B" battery is a stack of zinc plates coated with carbon on one side. The acid is contained in a small glass vial that sits inside of the "A" cylinders and just waits.

When the gun is fired, the setback force breaks the glass vial, releasing the acid. Once out of the gun, the centrifugal force caused by the spin of the shell at about three hundred fifty revolutions per second centrifuges the acid out between the plates of the "B" stack. Enough acid is retained between the two concentric "A" cylinders to

energize the A battery and light the filaments.

This is also a convenient safety feature since the battery is inoperative until the proper forces have been applied one after the other. It also made testing and experimenting with the batteries difficult, since an un-centrifuged battery did not produce.

The safety devices are many, and desirable. Shock of rough handling may break the vial of acid. Dropping a shell in excitement; or perhaps an enemy hit may open one of the mercury switches. Successive shocks may add up to progressive arming of the fuse. The twin-gate safety, however, requires spin, just as the battery does, since the latches and rotary gate all work on forces applied in opposing directions, and these forces must be simultaneous.

This is the Proximity Fuse. It is made of minute parts of very small mass to defeat the twenty thousand times gravity undergone during setback. It takes the kick of a big gun to operate the gates, switches, and other safety measures. And then a long chain of known principles act. They extend from the invention of gunpowder, by-pass Rube Goldberg, and end up with the last word in electronics. Endless rounds of test shells were fired in the development of the fuse. One such is shown in the picture, having been fired seven miles into the air up and down and into a specially prepared field for exhuming and examination. In one such test, a dollar watch was fired. No, it did not keep perfect time but it did show the designers how to make gears, pivots, and gadgets that would take the twenty thousand gravity setback force.

Antiaircraft gunnery has grown up to full stature. The Proximity Fuse comes from magazine or ready-box and is ready without fuse-setting. It can be delivered to any gun regardless of fired rounds or speed of past firing. It is ready at all times to be shoved into a gun and fired without preamble.

And when the supersonic rocket planes come over at fifty miles altitude, they will find rockets bearing Proximity Fuses coming up to meet them. The robombs will be blasted to bits before they come close enough to do any damage. And even the Divine Wind was forced to bow to man's control of the forces of nature—

THE END.

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Plan For a Universe

by R. D. SWISHER

There's a new theory of how the universe came to be—a theory that involves the creation of whole suns and galaxies by a single flash of energy. And there's the Swisher modification, that suggests that the right size energy flash ought to build a six-room house!

Two billion years ago, when the universe itself was two vigintillionths—2×10^{-63}—of a second old and had a radius of about one sexdecillionth—10^{-51}—of a millimeter, our sun absorbed a large photon, causing some of the solar matter to jump into orbits and form planets, just as a present day atom may absorb photons with resultant jumps of electrons to outer orbits. A hundred and fifty billion years before that, when the universe was 10^{-92} seconds old and its radius proportionally smaller the galaxies were formed by a similar process, upon interaction with still larger photons.

No, don't bother to return to that first paragraph just yet—you probably read it correctly. It summarizes, perhaps a little more trickily than need be, some of the content of "A New Theory of the Past" by the eminent biologist J. B. S. Haldane, an outcome, as he puts it, of "poaching on the preserves" of the eminent cosmologist E. A. Milne. Milne put forth the basic theory of kinematical relativity some ten years ago and has been foremost in developing it to its present state—still very fluid, and in many places even rarefied—as much as has been possible in the British total wartime economy.

From the basic assumptions that observers—very long lived, to be sure—may communicate by intergalactic light signals, and that the galaxies have the same general configuration for all observers, Milne emerges with the consequence that in the past light—and electromagnetic radiation in general—was emitted with lower frequency and consequently longer wave length

than corresponding light emitted today, the discrepancy increasing as we penetrate further into the past. The light reaching us from the distant galaxies was emitted by them long ago and is consequently of lower frequency than is corresponding light emitted today—hence the red shift observed in galactic spectra, with the shift proportional to the distance of the galaxy of origin, i. e. proportional to the remoteness of the time of origin.

Similarly, as time goes on light quanta emitted by excited sodium atoms, for instance, will have higher and higher frequencies and shorter and shorter wave lengths. The precision of present day spectroscopic work is such this variation may be observed in a hundred years or so: in 1907 the wave length of the red cadmium line as measured by Fabry, Perot and Benoist in comparison with the International Meter bar was .000064384696 cm., in close agreement with the value found by Michelson and Benoist in 1895. By now this wave length should have shrunk to around .000064384695 cm. and by 2000 A. D. it should be down to .000064384693 cm., but it would take another century or so to make the shrinkage definite, unless more accurate methods of measurement are devised.

The International Meter bar is a primary standard for our unit of length. However, for many years the wave length of that red cadmium line has been used also as a primary standard of length. Under Milne's relativity these two primary standards are not constant with respect to each other, and it is perfectly legitimate to consider the cadmium wave length as constant and the International Meter bar as expanding. And along with the International Meter bar are expanding the case in which it is kept, the room containing the case, the Institute, Paris, France, Europe, Earth, our solar system, our galaxy and our universe. The expansion is perfectly even throughout matter and space, and would be unobservable if it were not for the obstinate behavior of electromagnetic radiation in refusing to conform. In classical (!) Einsteinian relativity theory on the other hand the expansion of the universe appears only in empty intergalactic space where the cosmic repulsion force has adequate distance in which to act, intragalactic space remaining relatively constant in size.

In its present state Milne's theory regards the one viewpoint of static universe and decreasing emission wave length to be as legitimate as the alternate expanding universe with constant quanta, and sets up two time scales, one for each viewpoint. Dynamical or astronomical time represented by τ, is used in the static universe, and is measured by the old-fashioned methods of comparison with planetary rotation, and the like. In this unexpanding universe radiation is a misfit, due to the dwindling of the emission wave length of quanta as time goes on, and to the increase in frequency of the emitted quanta.

The alternate viewpoint considers that the wave length and frequency of the quanta are independent of the time of emission, and this is accomplished by means of the new kinematical time, t. When it is used it results that all the matter in the universe is contained in a sphere expanding at the velocity of light, i. e.:

$$r = ct$$

where r is the radius of the universe, or if you wish, of the sphere, c is the velocity of light and t is the kinematical time. Obviously as we proceed backward in kinematical time r becomes smaller and smaller, and finally becomes zero when $t = 0$. This can be logically taken as the time of the creation of the universe. From this viewpoint the expansion of the universe means that the galaxies are receding from each other, which means that their spectra will show the Doppler red shift, and from the observed value of the red shift as a function of galactic distance—100 miles/second /million light-years—it is easily calculated that all the galaxies must have been at a single point 1.86×10^9, or roughly two billion years ago. Thus the present time on the kinematic scale, called t_0, is 2×10^9 years, or 6.3×10^{16} seconds, after that initial time when the universe occupied a point with zero radius.

This finite sphere with present radius two billion light-years contains all the galaxies, of which there are an infinite number. The apparent paradox is not too disturbing, since classical Einstein relativity still applies, at least to some extent, and the galaxies near the surface of the sphere are traveling at a rate so near to the velocity of light that the Lorentz-FitzGerald contraction has flattened them to infinitesimal thinness, allowing an infinite number to be packed in without overcrowding. Most of them lie within a millimeter of the surface, and an infinite number of zero thickness ones comprise the surface itself. There is no more crowding of galaxies at the surface than in our own region at the center, since by the reciprocity of the Lorentz-FitzGerald equation the surface dwellers observe themselves to be at the center and us at the surface. From the dynamical time viewpoint the sphere is infinite anyway. Infinity is a wonderful concept!

Dynamical and kinematical times are, of course, interrelated, and Milne deduces the equation:

$$\tau = t_0 \left(\ln \frac{t}{t_0} + 1\right) = t_0 \left(2.3 \log \frac{t}{t_0} + 1\right)$$

Thus at the present time, when $t = t_0$, τ also equals t_0, or 2 billion years. As we go back in time, though, we cover more and more τ-years per t-year: two billion τ-years ago τ was zero, but that instant was only one and a quarter billion t-years ago; the universe was then three quarters of a billion years old, t-scale, and had a radius of three quarters of a billion light-years. If we go back approximately 1,999,999,999t-years, when the universe was 1 t-year old,

the τ time was —41 billion years, or 43 billion τ-years ago. When the universe was 1 t-second old, τ was —75 billion years—that instant was 77 billion τ-years, but only approximately 2 billion t-years ago; the radius of the universe, t-scale, was 186,000 miles. When the universe was one ten billionth (10^{-10}) second old, t-scale, τ was —121 billion years, the time was 123 billion τ-years ago, and still approximately 2 billion t-years ago. The radius was about three centimeters, but galaxies, stars and atoms were all smaller in proportion, so that an observer would notice no difference, aside from the relatively giant size of the photon wave lengths and their correspondingly low frequency. Going back still further to time $t = 0$, τ becomes minus infinity, which illustrates the satisfying concept that the universe has both a finite and an infinite age.

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Many of the laws of nature involve time, and when expressed mathematically represent various properties as functions of time. According to the Milne theory the time occurring in these laws is in some cases τ-time and in others t-time; no difficulty has been caused by this discrepancy because the two times pass at approximately the same rate unless we consider extremely long intervals. In general the laws which involve the interaction of material particles, such as those of mechanics and gravitation, as ordinarily formulated, involve τ-time, while the laws connected with interaction of material particles with radiation, such as those covering radioactivity and emission and absorption of photons, involve t-time. Of course any law can be expressed in terms of either variety of time, by appropriate transformations using Milne's relation between τ and t, but it is necessary to determine which type of time was under consideration in the original derivation of the law in question.

An atom requires a finite time to radiate a photon, and the photon has finite size. The radiation process involves t-time, and Haldane points out that until the universe was 10^{-15} t-seconds old—145 billion τ-years ago—it had not existed long enough for any atom to have radiated a quantum of visible light, and the diameter of the universe—.00006 cm—was barely as large as a single wave length of such a photon. Consequently the universe at that time contained no visible radiation, nor any of lower frequency; existence of higher frequency, shorter wave length radiation was possible. As we look further and further back toward the beginning, the minimum photon compatible with the dimensions of the universe in time and space becomes one of higher and higher frequency, and hence greater and greater energy content. Existence of such high energy photons in the early universe is postulated by Milne and Haldane —if we accept the existence of matter in the primal universe we cannot balk at a few photons, too.

If we go back to the instant when $t = 10^{-92}$, i. e. when the universe was a one-hundred-billion-billion- billion-billion-billion- billion-billion-billion-billionth of a t-second old, its radius was 3×10^{-82} cm. That was two billion t-years, or 502 billion τ-years, ago. Since $\frac{r}{t} \lambda\nu \frac{1}{t}$ c, a photon of wave length λ equal to the radius of the universe would have a frequency $\nu = \frac{1}{t} = 10^{92}$ vibrations per second, and would be somewhat too large to fit into the universe of that period, since a photon consists of a multitude of waves. The energy content of a single such photon would be $E = h\nu = 6.61 \times 10^{-27} \times 10^{92} = 6.6 \times 10^{66}$ ergs; no photon of less energy could exist in the universe at that time. Haldane points out that the mass of such a photon would, by the Einstein relation $E = mc^2$, be around 10^{45} grams, equal to the mass of a galaxy, and that somewhat after that time a minimum photon would still have enough energy to disrupt the presumable highly concentrated primordial matter into a galaxy. Taking this as the time of formation of the stars we are provided with some five hundred billion τ-years in which the dynamical interactions of the stars within a galaxy have taken place, all within two billion t-years.

Thus the theory resolves the difficulty of the short and the long time scales for the age of the universe—the short time scale is derived from phenomena occurring in t-time, while the long scale has plenty of room to fit into τ-time. Five hundred billion τ-years ago was just two billion t-years ago, minus an infinitesimal fraction of a second, while five billion billion τ-years ago was also just two billion t-years ago, minus a smaller fraction of a second.

Haldane considers that matter consisted of completely ionized nuclei and their electrons up to time $t = 10^{-8}$ seconds, because it takes around 10^{-8} seconds for the emission of the photons which must accompany the fall of electrons into atomic orbits, and because only by that time was the universe large enough to hold such energy photons. Alternatively, it should be equally reasonable that the primeval matter came neatly wrapped in its original packages, complete with the electrons in their lowest atomic energy levels, since only by $t = 10^{-8}$ seconds had the universe existed long enough for the electrons to have been knocked out of those energy levels. In either case before $t = 10^{-8}$ seconds most of the matter in the universe was, as now, in the form of stars, unable to radiate it is true, but probably closely resembling Emden's gaskugeln, which are simply spheres of gas obeying the laws of perfect gases, gravitation and hydrostatic equilibrium, and neglecting radiation. Because those three laws involve interaction of material particles they operate in dynamic τ-time, and had hundreds of billions of τ-years in which to take effect be-

fore the universe was old enough kinematically to emit the radiations corresponding to the stellar temperatures which Emden's gas spheres must possess under the three laws mentioned above.

A small fraction of a t-second after the creation of the galaxies, about 120 billion τ-years later, when $t = 10^{-66}$ seconds the universe was plenty large enough to contain photons of around 10^{50} ergs, which possessed about the right amount of energy to split a star in two and separate the fragments to the orbital distance of the long period binary stars. The energy increase necessary to form such a system was thus supplied by the absorbed photon, while the angular momentum must have come from the parent star, and the resulting orbits were quite eccentric since a parent star with enough angular momentum to give daughters with circular orbits would have been centrifugally unstable.

Sixteen billion τ-years later, when $t = 2 \times 10^{-63}$ seconds, the universe had a radius of 6×10^{-53} cm. and the sun had a diameter of around 10^{-69} cm. Haldane proposes that at that time a photon of frequency 10^{72}, wave length 3×10^{-62} cm, energy 6.6×10^{45} ergs, collided with the sun and was absorbed. "The sun, it is suggested, behaved much as an atom does when it absorbs a photon. A part of it took up most of the added energy, and a large share of the available spin, and became the planets." He points out that since the long period binaries are fairly common and were formed by a process very similar to this one for our solar system, it follows that solar systems are likewise fairly common.

The photon energy is indeed about enough to have raised the planetary masses from the surface of the sun to their present orbits, and the sun could have possessed the requisite angular momentum: H. N. Russell states that the present day sun would not be centrifugally unstable if it held fifty times its present angular momentum, roughly that of all the planets. However, a more ticklish aspect of the theory is the subsequent contraction of the ejected matter into gaseous spheres which cooled only by loss of their more volatile components—i. e. by evaporation—since this was long before thermal radiation was possible. The ultimate condensation into liquid was not supposed to be complete until $t = 1$ year, about 320 billion τ-years later. The ejected matter should be at stellar temperatures, just as the fragments in the collision theory of the origin of the planets, and even without radiation pressure it is difficult to see how a planetary-size portion of this witch's brew could exist as such for more than a few τ-months without completely dissipating into space as calculated by Spitzer in connection with stellar collision fragments.

If we carry Haldane's atomic analogy a little further, we find that we have a new possibility for

the end of the world. The solar system represents an excited state of the sun, and we may fear that any day now it may revert to its lowest energy level, the planets falling back with the accompanying re-emission of the super photon. We can only thankfully assume that the planets have existed for the past two billion t-years because the excited state is metastable.

As has been pointed out, the stars of this early universe were nonradiating gaskugeln; the temperatures of such spheres increase from the surface to the center. The central temperatures range in the millions of degrees, which means velocities of the component electrons and nuclei—or perhaps merely electrons and protons—large enough for nuclear reactions and synthesis of heavier nuclei once the elapsed t-time became great enough for such reactions, a period which Haldane places near $t = 10^{-6}$ seconds. By $t = 10^{-5}$ seconds the electrons had had time to settle into orbits about the nuclei with emission of visible photons, and the stars had begun to shine.

For the larger stars, shining was their undoing. A stellar mass greater than about one hundred or one thousand suns, although stable under the three τ-time laws, is decidedly unstable with respect to radiation pressure. The heavier stars became novae or clusters when gravitational attraction became unable to cope with the increasing floods of internal radiation made possible by progression of t-time. Smaller stars were able to dispose of their weaker radiation less catastrophically, and merely contracted as the energy was dissipated. Those with large initial angular momentum increased their spin so much during the contraction as to split under centrifugal force, and became the spectroscopic binaries. Since present day novae can radiate most of their excess energy in a year or so, Haldane believes that the primitive stars could have completed most of their radiation and contraction within one t-year, i. e. by $t = 3 \times 10^7$ seconds, 57 billion τ-years after the start of the process, or 43 billion τ-years ago.

The exponential law of radioactive decay states the observed fact that half of the radioactive nuclei in a given specimen will decay within a certain time, called the half life of the element in question, half of the remainder decomposing in the subsequent equal period, and so on. The energy produced by radioactivity is thus constantly decreasing. For example, the decay of terrestrial uranium—half life around 4.5 billion years—makes a substantial contribution to the maintenance of the Earth's temperature. Radioactivity is a phenomenon of t-time, so the time factor in the exponential law is measured in t-years. But from a terrestrial standpoint what is more important is how many uranium atoms decompose in a τ-year. Haldane converts the ordinary exponential expression into one in terms of τ-time by means of Milne's equation and shows that

when considered with respect to ordinary astronomical years samples of the radioactive elements do not decompose at a constantly decreasing rate, but at an increasing rate until a maximum is reached at $t = 1.44$ times the half life, after which the decreasing rate sets in. He calculates that uranium is not yet at its peak: it will contribute heat at 1.6 times its present rate when $t = 6.5 \times 10^9$ years, about 2.4 billion years from now, while thorium will not reach its maximum until 4.6 billion A. D., promising energy for geological activity for some time to come.

At least certain of the life processes are like radioactivity, constant in kinematical time—those which depend on reactions originating within single molecules as opposed to reactions depending on collision between molecules, which latter Haldane presumes to be governed by dynamical or τ-time. It would seem doubtful whether a sharp distinction can be made legitimately, since the two molecules concerned in a bimolecular reaction may be considered as forming a single complex molecule the decomposition of which would then occur in t-time. (Similar considerations may apply to collisions between atoms and to collisions between material particles in general, which in the last analysis would involve collisions between the component atoms of the particles: at the moment of collision the two atoms might form a quasi-molecule which would then decompose in t-time. In the early days of the universe, up to $\tau = 10^{-10}$ seconds or so, the result would be that the quasi-molecule would be practically immortal in τ-time, building up like a rolling snowball as more and more atoms collided with it. How such behavior could be reconciled with the classical laws of motion and what would happen when t-time finally progressed enough for the giant molecules to decompose again we leave to the Newtonian mechanic and the wave mechanic respectively.)

In any event, however, Haldane considers that since the rate of energy liberation by muscle tissue, dependent upon the decomposition of complex protein-nucleotide molecules, is constant in t-time, while gravitation involves τ-time, it follows that in the distant past a muscle fiber would have had much more difficulty in operating against gravity, due to the changed ratio of t-time to τ-time. He calculates that at the time of the dinosaurs muscular effectiveness would have been cut by about ten percent. Similar considerations assuming that diffusion is a process involving τ-time, point to a time in the past before which existence of cells was impossible because the rate of energy liberation was not sufficient to prevent the loss of vital cellular material by diffusion. Previous to that time only virus-type life would have been possible. Assuming that photosynthesis is accomplished only by cellular life this limiting time may be placed at least as far back

as the appearance of oxygen in our atmosphere, which from geological evidence was around $t \backsimeq 10^9$ years, about 1.4 billion τ-years ago.

Haldane sees the universe of the future becoming even more propitious for life, as the energy liberation rate with respect to τ-time becomes greater. He can envisage a somewhat modified type of life existing at a million billion t-years—26 billion τ-years—in the future, after the stars have cooled, perhaps deriving energy from the electric and magnetic phenomena which come into play in the region of absolute zero.

Haldane observes: "Once one has grasped the main features of Milne's cosmology, one can now argue from it without using anything but arithmetic and common sense." His estimate is ultra-conservative: much can be done with arithmetic alone, so let us dispense with the understanding and the common sense and do a little poaching of our own. In Haldane's chronology the various phenomena of creation occurred soon after the universe became large enough to hold photons of proper energy for the job in question, but it is not clear just why this should be so. Prior to that time quanta held more energy than was necessary, but might still have been involved in the process with conversion of only a part of that energy, in the manner of the Compton effect, or perhaps the Raman effect, and at any time after the universe became large enough to hold a photon of proper energy, those photons should still be present.

Thus Haldane places the formation of the solar system at $t = 2 \times 10^{-63}$ seconds, by means of a photon of frequency 10^{72}. But at a considerably earlier time the reaction might have taken place, the energy being supplied by a quantum of the considerably harder radiation then extant giving up a small fraction of its energy, just as a γ quantum may give up a small portion of its energy to an electron in the Compton effect. Further, there is no apparent reason why the planet formation could not take place at a much later date—even now: today's universe is certainly big enough to hold a sun-buster photon.

Haldane stresses the fact that radiation is constantly being degraded by passage of time: in the dynamical universe by the fact that radiation emitted long ago had longer wave length than now, or in the kinematical universe by the Doppler effect produced by the expansion. A quantum of that 10^{72} radiation of the epoch $t = 2 \times 10^{-63}$ would, if it had traveled unabsorbed from that time to now, be observed by us as a king-size radio wave, frequency about .03 microcycle, wave length some ten trillion kilometers, or one light-year, and energy entirely negligible. Such is the wasting-away caused by its chasing us for the past two billion t-years at the velocity of light before catching up with us; we could not expect it

to have enough energy left to create a solar system here and now after such a journey. In order to have a frequency of 10^{72} now, the primitive photon would need the relatively huge frequency of 3×10^{151} at $t = 2 \times 10^{-63}$ seconds, but who is to say that it could not have existed? Alternatively, 10^{72} photons could be emitted by recent collapse of solar systems. In either case, the formation of our solar system could have taken place considerably later than in Haldane's chronology.

But could it? Our solar system has a radius of around 5×10^{14} cm out to Neptune's orbit. The wave length of a 10^{72} photon would be 3×10^{-62} cm, a ratio of about 10^{76}. Can we suppose that two structures of such vastly dissimilar sizes could interact? One might expect the dimensions of the wave length to be of the same order of magnitude as those of the emitting or absorbing system. This intuitive supposition is not too well borne out by reality—an atomic nucleus of radius around 10^{-12} cm emits γ rays with wave length one hundred to ten thousand times as great, and the same relation exists between the dimensions of the atom and the wave length of its radiation, but the discrepancy is small indeed compared to that between a present day solar system and a photon of corresponding energy, frequency 10^{72}. If we look back to $t = 2 \times 10^{-63}$, however, we find that the radius of the solar system is around 1.5×10^{-63} cm, about one two thousandth of the wave length of the 10^{72} photon, a ratio in complete agreement with those for modern atoms and nuclei.

We may suppose that for a given process involving an amount of energy E, accomplished by emission or absorption of a photon of energy $E = h\nu$, there is an optimum ratio between the wave length of the photon and the dimensions of the material system, and say that as the ratio departs from that optimum value the chances of the process occurring become smaller. This means that for any given process there is a time when the chances of it occurring are greatest. the time when the photons involved have both the proper energy and the proper size. Depending on how slowly or rapidly the probability of the process falls off as the size ratio departs from its optimum value, the era in which that process is possible will be longer or shorter. If, for instance, we assume that interaction becomes negligible when the size ratio is below unity or above one million, the process will occur only during about 28 billion τ-years of the universe's history, or during a millionfold increase in t.

We cannot vouch for the understanding or the common sense, but the arithmetic says that

$$t = \frac{h}{EKR} = \frac{\lambda}{cKR}$$

where

t is the date in t-seconds when the size ratio is optimum

h is Planck's constant $= 6.61 \times 10^{-27}$ erg sec

E is the energy in ergs involved in the transition

K is the ratio of structure radius to galactic radius

R is the optimum ratio of wave length to structure radius

λ is the wave length of the photon of energy E in cm

c is the velocity of light $= 3 \times 10^{10}$ cm/sec

Assuming, for want of a better value, that R is 1000, we find that the optimum t for solar system formation was around 10^{-62} seconds, for long period binaries around 10^{-67} seconds. Calculation for a galaxy must wait until we can find an estimate of the energy necessary. Structures larger than galaxies have K values so high as to cause difficulty unless relativity corrections come into play—as K approaches the value of 1/R the photons required would no longer fit in the universe. Atoms and nuclei have optimum times near the present, since we chose R to fit the present values for such systems. It was also of interest to calculate the optimum era for the creation of a house by this process of photon absorption—a ten thousand dollar seven-room house of approximate radius 15 feet or 500 cm. The main difficulty lies in determining the energy necessary to build such a structure, but we may get an approximate estimate from the cost. If human labor is worth one dollar per hour and the laborer works at the rate of one tenth horsepower, ten thousand dollars represents about 3×10^{16} ergs; using this figure the optimum time for building houses by the radiation process was at $t = 10^{-21}$ second, a time when all the matter in the universe was in the gaseous state. This undoubtedly represents the origin of the "all gas house" we used to see advertised a few years back in real-estate subdivisions.

At time $t = 10^{-3}$ second, when Haldane assumes visible thermal radiation to have been well established, the atomic radius was around 1.6×10^{-22} times the present value, yet the wave length was the same as now. That means that atoms were emitting waves a million-billion-billion times as long as their own dimensions. If we wish to apply an upper limit of a million times, neither atomic nor nuclear radiation processes were possible before 14 billion z-years ago, or when the universe was two million

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t-years old. A lower limit of unity for the size ratio would mean that such processes would discontinue in about 14 billion τ-years, at t = one trillion t-years. At that time we might expect to find excited atoms with electrons in outer orbits, unable to drop back because the resultant photon of proper energy would have too short a wave length for the atom to emit, just as today our solar system is perhaps unable to revert to its ground state—sun-without-planets—because the wave length of the required photon is far too short to be compatible with the dimensions of the emitting system. In the distant future we may not be surprised if we find that sizes have changed enough so that interaction of radiation with intra electronic or intra protonic particles has become important, and can imagine the difficulties besetting the denizens of that remote time in trying to formulate a workable theory for the origin of the practically dead oxygen atom that they inhabit.

Bibliography:

Haldane outlines Milne's theory and his own speculations in "A New Theory of the Past," American Scientist, July 1945. The following articles give very interesting summaries of planetary theories and cosmology:

E. E. Smith, "Catastrophe," Astounding, May, 1938.

Arthur McCann, "Hot Filament," Astounding, May, 1940.

R. S. Richardson, "Late-Model Stars," Astounding, Oct., 1942.

R. S. Richardson, "Extra-Solar Planets," Astounding, Sept., 1944.

R. S. Richardson, "Time for a Universe," Astounding, Nov., 1944.

HALDANE'S CHRONOLOGY

t	τ, billions of years	t-years ago, billions	τ-years ago, billions	phenomena
10^{-28} sec.	−500	2	502	galaxies
10^{-26} sec.	−380	2	382	long period binaries
2×10^{-22} sec.	−364	2	366	planets
10^{-3} sec.	−112	2	114	nuclear reactions, visible light
10^{-2} sec.	− 98	2	100	stars radiate and contract
1 sec.	− 75	2	77	
1 year	− 41	2	43	spectroscopic binaries
10^{8} years	− 13	1.999	15	clusters, novas
$.74 \times 10^{9}$	0	1.26	2	
10^{9}	.6	1	1.4	cells, photo-synthesis
1.82×10^{9}	1.8	.18	.2	dinosaurs
2×10^{9}	2	0	0	NOW
6.5×10^{9}	4.4	− 4.5	− 2.4	uranium peak
20×10^{9}	6.6	−18	− 4.6	thorium peak
10^{11}	28	−1,000,000	−26	stars cold

THE END.

IN TIMES TO COME

In the last few months, several new authors have shown up in the pages of Astounding; in the months to come there will, undoubtedly, be more. It's essential to healthy science-fiction that a continuous supply of new thoughts, new viewpoints, and new techniques of story-telling be added. The addition of one or two new authors can do a lot of good for the whole field, because, inevitably, the fresh viewpoint of the new men will tend to start new chains of thought in the minds of all writers.

The Analytical Lab this month shows that one author new to Astounding—Emmet McDowell—made second place against the very stiff competition of Lewis Padgett and several other long-familiar names, while a second author, Philip Latham, took third place with his first piece of fiction. That, I think, is a very good showing.

Next month we have another new author. Chan Davis is a new man; this is his first piece of fiction. He's been in the Navy through the war, and read science-fiction for a considerable while. His story's called "The Nightmare," and has the unusual distinction of taking the cover. It's an atomic bomb story, and a genuinely unique approach to the whole problem.

There are a number of factors that go to select a story for the cover spot. Naturally, the author's name-value is usually a major consideration. It's got to be a good yarn, should be a novelette or novel installment. But many a first-rate yarn, by a first-rank author simply isn't illustratable. Some of the tensest psychological drama has to do with someone simply waiting quietly, doing nothing at all, or doing simple routine. Such a story may be first-class stuff—but useless on a cover.

Davis, being a first-time author, naturally doesn't have name-value as yet. But the story's good, and Timmins was able to find in it the material for a magnificent cover.

Chan Davis will be back—and so will many of the new authors who are beginning to appear.

THE EDITOR.

THE ANALYTICAL LABORATORY

As mentioned above, one of the most interesting features of this Lab is the high standing two brand-new names earned. The scores worked up this way:

Place	Story	Author	Points
1.	The Fairy Chessmen	Lewis Padgett	1.8
2.	Veiled Island	Emmet McDowell	2.7
3.	N Day	Philip Latham	3.3
4.	The Plants	Murray Leinster	4.0
5.	Fine Feathers	George O. Smith	4.1

THE EDITOR.

Black Market

by RAYMOND F. JONES

An O.P.A. agent's job is to stop black market operations—but the job that faced him was something no ordinary measure could handle. Targ advertised his Black Market Emporium—but not the source of his strange and wonderfully efficient goods!

Illustrated by Orban

George Billop, Chief Price Investigator, sat by the desk in the living room and fingered the letter from Harold. His eyes stared into space across the room. Then he glanced down at the letter and slowly reread it:

Dear Dad:

Two things happened today, one good, one bad. The good one was my major's commission which just came through. The bad one was your letter—or rather, the things that were in it. I was disappointed in your decision to resign your job and go back to commercial insurance investigating because you hate the spying on people that you have to do.

I understand how you feel. Over here I've seen the results of tattling and spying, this setting every man against his neighbor which has been one of our enemies' specialties. But that's not what your job requires. Above all, it must not

fall into that. To prevent it, men like you must stay on the job. Sure, there are plenty of fresh college punks who act like Gestapo graduates. It's up to you and others like you to overcome the harm these misanthropes do. The job has to be done, you know. I don't have to remind you that it's the foundation of economic salvation back home during these times. You say that ninety-nine percent of the price violations are merely due to misunderstanding and lack of information, that you don't want to treat these little guys who are your neighbors as felons. All right, see that you don't. But to keep others from doing it, too, you've got to stay on the job and do it right.

When it's done wrong there's animosity, bitterness. One instance is bad. Multiply it by a million, fifty million—and you have what we have in the world today. It's not corny today to remind you, Dad, that "Blessed are the peacemakers." And you have a greater opportunity in that greatest of all jobs, peacemaking, than I have.

You say that a man pushing sixty has no place in today's world. Consider the punks you've told me about in your office and I don't have to answer that.

But speaking of duties to perform. They say I can never fly again now. Grounded for eight months already, they've stuck me in a little office to interview returning pilots. They call me an Intelligence Officer and say my job is very important. O.K. I'll take their word for it, and do it even though there're others I'd like far better. I'm doing what I'm best fitted to do in this war. So are you. Keep at it, Dad.

George Billop laid the letter down and picked up another—his letter of resignation that he had been working on when Harold's letter arrived. He tore the sheet in small squares and dropped them into the wastebasket.

He finished the dressing that had been interrupted by the determination to get his resignation in and get it over with. Be through with this spying and getting harmless little guys into trouble. He wanted to get back to the world of industry, machinery, facts, figures, and equations. There, men acted like human beings and didn't bind every breath with a mile of red tape and a threat of ten thousand dollars fine and/or two years' imprisonment.

But he hadn't stopped to see it all the way through as Harold had done, George reflected. He'd been thinking too much of the personal angle, his own subjective reactions. He had forgotten the plain fact that if he quit the job someone else would do it far worse than he was doing it.

He put his hat on and headed out and down the street towards Smith's Grocery & Meats.

He didn't know Smith personally except as a complaint on an OPA list. But he knew Smith, he thought, as soon as he entered the door. He had seen Smith behind a thousand counters, worriedly passing out scarce commodities, listening to the diatribes of neighbors and former good friends who accused Smith of saving his best cuts for "that new Mrs. Jenkins in the next block. What does she pay extra for that?"

Billop went through the door and glanced around the neat shelves. Slightly graying at the temples, wearing an immaculate dark-blue suit and iron-gray felt, Billop might have been the president or at least

the head salesman for one of the firms in whose good graces Smith was anxious to remain in order to maintain his meager allotments of goods.

"Good morning," Smith greeted amiably. Mrs. Smith, waiting on customers at the other counter, nodded.

"Hello," said Billop. "I'm from the OPA."

Instantly, Smith's face froze into a tight mask. "O.K." he said wearily. "There're my shelves. What have I done now?"

Billop looked at the list in his hand. "Just a routine check, but I do have a little item here about cocoa. Two cents above ceiling. Probably just a mistake."

"A felon for two cents," said Smith bitterly.

"No one has called you that," said Billop.

"Last month it was a bottle of syrup. Two cents. And I had to sign a confession asserting I was a felon and that it was my first offense. I suppose this is going to cost me ten thousand dollars and two years in jail. Or is it twenty, now? It doesn't make much difference. Martha and I have decided to quit the store, anyway. It looks like we waited too long."

"It isn't as bad as all that," Billop said kindly. "No one has called you a felon on *this* two cents, anyway. I'm sure I won't."

Smith's eyes lighted. "Maybe the war has left some human beings, after all."

"Let's get this cocoa business straight. According to my sheet the ceiling price is 21¢ on the can you have for 23¢."

Smith nodded over Billop's list. "I guess you're right. I can't keep up with it. One week it's down. Next it's up. I get a list of prices. No indication as to whether they have been changed or not. I have to spend my nights plowing through the whole list from liniment to horse blankets to find which items I sell and the prices. It would take Superman himself to keep up with all that mess without a mistake."

"I know what you mean," said Billop. "I have the same trouble. Straighten out that cocoa price and there won't be any trouble about it. And here's my phone number at home. Call me any time after hours and I'll be glad to help answer your questions. I keep track of the changes on each list and I'll be glad to tip you off and save you some of the work of plowing through our sheets."

"Thanks," said Smith softly. "You're a real human being—and I thought there weren't any left. This war seems to have done something to people, and it's not a kind thing. Friendship, courtesy, kindliness—they seemed to have become old-fashioned when rationing was invented."

"Not quite," said Billop, "but it's up to you and me to keep those things alive."

Smith gave a friendly grin and shook his hand, and Billop was suddenly very glad that he had never sent in the letter of resignation.

As he approached the doorway,

he passed the line of customers that Mrs. Smith was checking out at the grocery counter.

He paused, then turned to glance about the shelves to hide the reason for halting. His ears had picked up an excited conversation in the line of customers.

A high school girl was confiding: "But Mary, you don't have to worry about gas and tires any more. Daddy says he knows a place. We're even taking a vacation in the car next week."

Billop breathed deeply and silently thanked the fates that seemed to have blessed him with one of those rare chances to prove that his job was really useful instead of mere harassing of little guys who made mistakes because they got tangled in messes of red tape.

He listened for more from the girl regarding the "place" her Daddy knew. There was nothing more from her, however, a little detective work and questioning of Smith gave him the information that the girl was the daughter of Paul Smithers, a shipyard electrician.

Smithers, he also learned, had recently acquired a new set of tires, but when he questioned Smithers' ration board they reported they had not issued any tire rations to Smithers.

The rest was simple. Smithers confessed his black market patronage after only a moment's hostility.

"But they're selling them to everybody that comes along!" he said. "There's no shortage. This guy has all the tires you want. And loads of other stuff, too. Washers, refrigerators, irons. He doesn't bother about rationing on any of them."

"We'll have a talk with this gentleman," said Billop. "But don't try to get away. You're as liable under the law as he is, but we sometimes overlook a small fry to catch a big fish. Understand?"

Smithers wiped his brow. "Yeah, I get it. I'll do all I can. I know it's not right to get stuff this way, but this guy seemed to have all anybody could want of it."

"I'll be back to see you later. Leeville, you say the town is?"

The Leeville highway was a traffic cop's paradise and not a single officer was in sight. The volume of traffic amazed Mr. Billop. He thought of his own purpose on that road. Could it be possible that all these others were headed for the same destination?

His guess was correct. Leeville was at a junction of two major highways and all four roads leading into the town were heavy with traffic. When Mr. Billop pulled up to park he was still ten blocks from Leeville's one-horse business district.

His blood slowly rose to a vigorous boil as he followed the crowd towards the center of attraction. Cars and trailers loaded with washers, refrigerators, cook stoves and tires weaved through the street. He suspected that the fifty-gallon drums which were so much in evidence were loaded with forbidden gasoline.

The focal point of the crowd was a not too conspicuous building marked

Leeville Mercantile Co.
Targ & Son.

In front of the store three gas pumps served an endless line of cars, most of which carried five to fifty gallon cans somewhere.

In the show windows were appliances of all kinds. Billop rubbed his eyes at the scene out of a prewar world. In the depths of the store could be seen piles of tires being doled out to eager customers who obviously had no ration certificates.

Even if these black market operators had such a stock as this store indicated they should be doling it out under the counter at fancy prices. Billop just didn't get it, but a warning buzz generated somewhere in his imagination told him to take it easy. This looked like big-scale stuff.

He relit his cigar while he looked over the surroundings. Nothing unusual. It was just a country farmtown—had been until this strange black market blossomed. Now it was bursting at the seams.

Billop stopped a farmer. "How long's Targ been here? I don't seem to recall his store."

"Just came in last week. Looks like the war is about over the way he's selling stuff we thought was rationed."

"How do you know it isn't?"

"Targ says rationing doesn't mean anything to him and so why should it to us?"

"What does the local ration board say about it?"

"Haven't heard, but I got me a new refrigerator."

They had probably wired for an investigator from Washington, George thought, and soon an M.A. in economics, CAF-6 at $2600 per year would be bustling all over the place. George Billop shuddered at the thought.

He entered the store. It looked like Saturday afternoon in a defense town. The placid salespeople were quietly taking the customers' money and assuring delivery of goods within a day.

Billop approached one. "I'd like to see some 6.00 × 16 tires."

"Surely," the clerk said. "A full set, of course?"

"I can use a full set," said Billop. "And . . . uh, I have a neighbor—"

"Surely. Two sets of 6.00 × 16 tires. Complete with tubes. And you'll want two spares in each set, of course."

"Yeah . . . yeah, of course."

This guy had been taught by Elmer Wheeler, Billop decided.

"We can deliver those this afternoon. Will there be anything else?"

Billop coughed. "Uh . . . how about a receipt?"

"Receipt?"

"Yeah."

"We aren't in the habit of giving those. So much waste of time and material, you know."

Cagey, Billop thought. He'd bet they weren't in the habit of giving receipts.

"I'm on an expense account. I

can't take the tires without a receipt."

Surprisingly, this produced results.

"Please see Mr. Targ at the rear of the store. I'm sure he'll be glad to satisfy you."

George Billop walked towards the rear expectantly. This man, Targ, should be interesting. A front, of course, for the real operators.

"Come in, Mr. ah—"

"Billop."

"I'm happy to welcome you to Targ & Son, Mr. Billop."

Targ was tall, dark, and serene-looking as if nothing had ever worried him. Billop vowed he'd have worries soon.

"You wished to see me about a receipt?" Targ said.

Billop decided the clerk must have phoned from the front. "Yes. You see, this expense account of mine—"

"Don't mention it," said Targ. "It's a small matter and we are happy to accommodate customers who insist by special request. But overhead costs, you know— We are anxious to sell at the lowest possible price to the consumer."

"I'm sure that's agreeable to the OPA," said Billop.

Targ's face grew dark. "We have nothing to do with the OPA! So far we have not been molested and if they let us alone, we will meet them on a fair and competitive basis."

Billop struggled to keep his mouth from dropping open. Targ spoke like some ballooned Nazi from the inner circle. He wanted nothing to do with the OPA!

Billop felt he had to get away to think for a minute. He was certain now that this was some enemy trick which was only a cover for something far more deadly than mere black market stuff. He accepted the receipt which Targ readily prepared for him, and left.

On the way out, he stopped by the display of laundry machines. Laundriers, they were called. Billop didn't recall ever seeing one just like these.

"All you do is place the bundle of soiled clothing in one end," the salesman was explaining to a group of eager housewives, "and presto, in less than thirty minutes the entire bundle is delivered—washed, dried, and ironed—from the other end."

The women squealed with delight. It sounded phony to Billop. A machine like that would cost a couple of thousand dollars if he knew anything about process engineering for mass production.

"You say it's priced at less than a hundred dollars?" said a housewife excitedly.

"Ninety-nine, fifty. We can deliver this afternoon."

"Give me one!" demanded Billop. "Here's a hundred dollars."

With obvious irritation, the women made way for him. He did not reopen the question of a receipt. The tires were enough to hang this gang. But this Laundriet was something else and it prickled

the edges of Billop's scalp and fingered its way into his imagination.

At a reserved thirty-five miles an hour it seemed to Billop that it took him a week to get home. Actually, he was two hours before dinner and he was alone in the house. Except for the tires and the Laundrier. They were waiting on the back porch when he arrived.

In his garage shop he quickly uncrated the Laundrier and brought out a pile of laundry. The machine needed neither soap nor water, but operated with a sealed-in chemical which was completely recovered as the clothes dried.

Billop placed the laundry in the machine and shut it up. The operation could not be observed. but the machine hummed satisfactorily.

While he waited, Billop took one of the new tires into the backyard and attacked it with an ax. After a strenuous fifteen minutes he got a look at a cross section of the tire.

There was no cord in it.

The tire was laminated with layers of what appeared to be homogenous material, but which varied from maximum elasticity at the tread to almost total inelasticity on the inner surface.

Billop knew those tires were not made by a technique current in the rubber industries of any country from which information was available.

By this time the Laundrier had proven its abilities. A pile of neatly ironed and folded clothes lay on the receiving shelf. For a long period he contemplated the miracle of the Laundrier, then he turned it off and made a selection of tools from the shop.

Right at the start he was stymied. The case of the machine was a single seamless box without discoverable fastening. He resorted to use of the cutting torch and it was like trying to cut porcelain. The stuff wouldn't melt. After long heating it flared to incandescence and slowly dropped away as white powder.

He finally had the case cut away. The interior looked familiar enough in its assembly of driving motor, wheels and levers.

But unfamiliarity reared up again when he tried to turn one of the nuts to dismount the motor. It snapped like a rachet but held firmly as he turned—in both directions.

It took him forty-five minutes to discover that those nuts were to be loosened with an oscillatory motion and whether they tightened or loosened depended on the first motion. When he finally had one off it made him dizzy to stare at that crazy looking double spiral thread on the bolt.

But his imagination raced ahead at full steam. That screw was a concept utterly alien to normal mechanical ways of thought. It was ingenious, but it could hardly boast a practicality that would make any process engineer put up with the difficulty of machining it. Foreign engineers, more concerned with ingenuity than speed and ease of production, might have conceived it. But it was not Japanese at least.

Their minds didn't work that way.

He tried the motor next, and it was necessary to use the torch again. The motor had a curious double armature. Two halves mounted on the same shaft revolved in opposite directions to no good purpose that Billop could see. He suspected it might have something to do with making the motor adaptable to power supplies of varying frequencies and voltages, but he couldn't be sure.

The rest of the machine was similar. On the surface it looked wholly familiar. Then a closer examination revealed something like those double-action bolts and the opposing armature.

The ironing mechanism was a mass of reciprocating rods that drew out articles from the washing chamber and thrust them between heated rollers. The refinements that made it adaptable to all sizes and shapes of articles baffled Billop. Articles apparently were ballooned out by a blast of air that also assisted in drying. The silhouette of the article thus ballooned was picked up on a sensitive screen which controlled the levers so that the cloth was fed to the rollers without wrinkling.

It was long past midnight when Billop finished his work, and he knew finally that he could never make a complete examination of this machine. It would take a crew of engineers, chemists, and physicists a month at least to get down to the fundamentals of the thing.

But learning those fundamentals was not the problem. The problem was who *did* know those techniques so familiarly that they could design and build such a machine as the Laundrier? Certainly they were not in existence before the war and it was inconceivable that any of the belligerent nations would have devoted time enough from war projects to develop the Laundrier.

Billop thought of his son, Harold, who had made a hobby of science-fiction writing before joining the Air Force. The two of them had made it something of a game to postulate a society with mores wholly different from those in human relationships. They had frequent heated discussions concerning the actions of a member of such a society faced with various problems. Most of these discussions went into publication as science-fiction.

A possibility that seemed straight out of Harold's catalogue of science-fiction plots occurred to George Billop. It was that the Laundrier was not what it purported to be. So much of its workings were incomprehensible that it was easy to imagine the appliance as some diabolical machine which was being distributed throughout the nation by the enemy. Perhaps hidden in its innards was a lethal ray projector, or one that would act horribly on the minds or bodies of those near it.

A Trojan horse.

There was much against it, however. The double action threads for example. They served no good purpose. They were unnecessarily

complicated for production by any conventional methods.

On the other hand their ingenuity might be useful if they could be produced easily by some unknown techniques. That would imply an entirely different technical culture from anything previously known.

But a solution of the mystery of that alien technical culture was information that would have to come from Mr. Targ himself.

Dawn found Billop again on the road to Leeville after a restless three hours in bed during which time his subconscious was rampaged by enormous Laundriers romping over the landscape disgorging little buck-toothed Japs.

He was still sweating a little from the reaction of the nightmare as he neared the village. He was suffused with the urgency of the situation and the necessity of personally taking care of it. Anybody with only normal imagination would be sure to botch it.

And that urgency grew as he noticed a new signboard going up at the city limits. It read:

Welcome to Leeville
The Ration Free Town.

He fumed and tried to imagine what kind of a double barreled idiot on the Chamber of Commerce had authorized a sign like that. All the OPA investigators in the country would pounce on the town.

He stopped first at the Ration Board office. Only the clerk was in.

She sighed as if she had suddenly been relieved of a terrible burden. "Oh, I'm so glad you're here! The town's gone crazy. That store, Targ & Son, is selling things like they'd never heard of the war. I'd like to see them locked up for a hundred years. Think of the guns, the bullets—"

"Yeah, yeah, I know," said Billop impatiently. "I'll see that they are put away. But I want you to co-operate by doing nothing at all. Let me handle it completely, and if other OPA investigators contact you tell them I am here in charge of the job."

Billop then crossed slowly towards Targ & Son. The stock piled in the store was as great as the day before. The stack of tires seemed not to have dwindled at all, and there were just as many Laundriers and Coolservers despite the enormous sales.

He strode in and was recognized by the clerk who had waited on him the day before.

"Ah, Mr. Billop! May we help you this morning? It's good to see you again."

"Mr. Targ, please."

"In the office. He'll be glad to see you."

Targ opened the door almost the instant Billop knocked. He was smiling affably and extended a hand.

"Mr. Billop. I'm so happy you're come back. Please come in and tell me what we can do for you now."

"I took one of your Laundriers apart last night."

"So?"

"It doesn't fit, Targ. None of it fits."

"What do you mean, it doesn't fit?"

"Doesn't fit our technological culture. You should have thought of that before you brought these things in. The same with the tires. We make them with cord. You should have examined a sample more closely."

"Ours are better, I'm sure."

"Too much so. That's why they don't fit."

Targ sat down on the edge of the desk and cupped his chin in his hand. He eyed Billop for a long time. "What do you want?" he said at last.

"What do *you* want?"

"We want to do business peacefully. Apparently we are satisfying the needs of a great many people for we have done a wonderful volume of trade since setting up our new store. Do you have any objections?"

"Quite a number," said Billop.

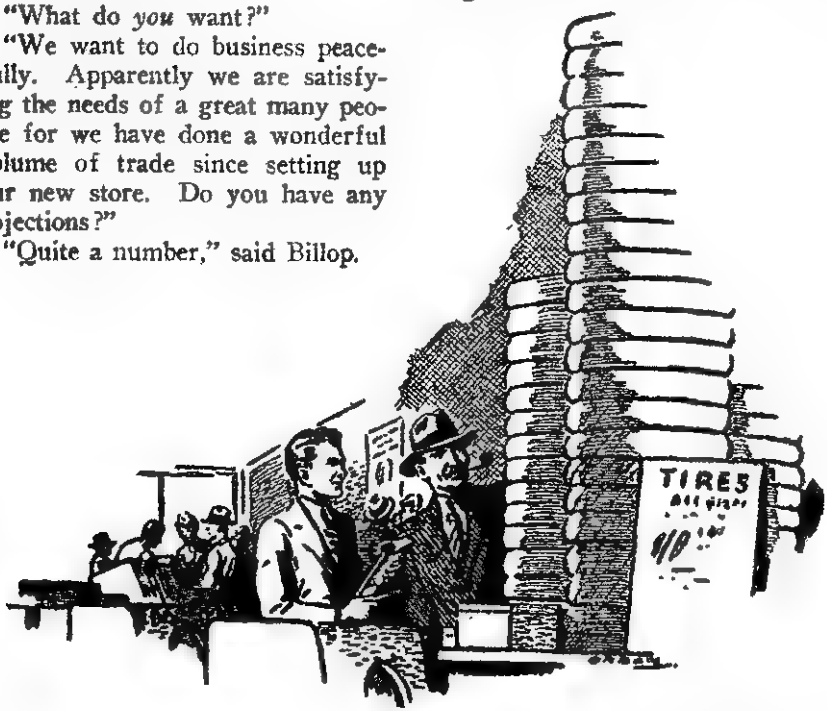
"You are from the Hoppa . . . the OPA, rather—?"

"That's right. What was that you called us—the Hoppa?"

"Yes."

Billop's imagination staggered under the impact of the significance of that word. No contemporary culture would have distorted the three-letter abbreviation into a pronouncable word of that kind. Such a thing could occur only over a period of time, a long time. Billop thought back to the times when he had discussed the possibilities of future cultures and debated their characteristics with Harold.

He leaned forward and suddenly demanded, "*When* are you from, Targ?"



"So you know," sighed Targ. "We have made too many mistakes in this venture."

Billop nodded agreement. "Mistakes that the OPA or the Hoppa if you will, doesn't like."

"You don't look like a terrorist," said Targ. "You seem to be a rather mild individual. Barbarism probably runs deep in this era, beneath a thin shell of neoculture."

Billop's brain grasped each thread of a clue in Targ's speech, hoping it would lead somewhere. "I'm afraid it does," he said. The OPA doesn't like the kind of mistakes you have made."

"History has never made your motives quite clear," said Targ. "Granted that you are a group of monopolistic commercialists in the role of religious fanatics, is it your aim to eliminate all but favored commerce, or would you be willing to permit new ventures that agreed to operation under your sanctions?"

"It rarely happens," said Billop. "We don't like newcomers. They seldom want to conform. We call them black markets."

"I've heard the term whispered about since I came, but it's an idiom I could not grasp."

"Suppose you give me your story. Then I can make a report to my chief so he can make correct disposition of you."

"History has prepared us for meeting with the Hoppa," warned Targ. "We came prepared to ward off physical violence."

"Let me hear your story."

"I am Volbar Targ, son of Simar Targ. We are one of the largest distributors in the Commercial Age, approximately three millennia distant. Probably your barbaric mind will find it difficult to conceive the type of commerce we have in our home age—you *are* barbarians, after all, you know."

Billop let that one pass and Volbar Targ went on. "Long before the Commercial Age the point of customer saturation was reached. All types of products were producable in such tremendous quantities that they could not be consumed by the demands of the current age. Then came the miracle of time travel. With all the ages of history open to us, it was thought that overproduction surely would never plague us again.

"By government appointment, each manufacturer and his distributors are given a franchise to open a sales territory in a particular age of the past or in a group of ages. The products manufactured are of such a nature that they satisfy the needs of the era, yet are just a bit more advanced in engineering so that they may compete in a decidedly favorable manner with contemporary products. All this is done through a contemporary advertising front and in a manner to make it appear as the product merely of advanced contemporary engineering."

"That's the point you muffed on this deal," said Billop.

"You are right. The explanation will appear."

"You must have had to be pretty

careful not to give yourselves away in any other age. That would require an intimate knowledge of language and customs and laws of the age."

"You have no idea what a tremendous task it is. That is our biggest single item of overhead expense—maintaining research bureaus that will enable us to conform to the mores of the age in which we open a territory.

"It is the one universal commandment of the Commercial Age that we do not betray ourselves to the contemporaries—a commandment few of us have broken until now. It is obvious that we cannot go into a territory and sell to customers to whom we are outcasts because of violation of their mores. That's why I questioned you about obtaining permission to operate under OPA regulations. At first I thought perhaps we would not be molested. I should have known you when you first came."

"I'll have to see the chief about it," said Billop dubiously. "But why did you muff things so much in coming here?"

"The farthest back that we had formerly come was the year 2755, the Boundary Age. Earlier eras we lumped as the Barbarian Ages. Because of the primitive culture that we found in the twenty-eighth century and the remnants of history concerning your times it was always felt that it would be impossible to operate any earlier than our last outpost store in the Boundary Age.

"But the great dream of the Commercial Age finally turned into a nightmare. On the heels of the discovery of the potential markets in the various ages, new productive enterprises were founded, all with government sanction, of course. These poured out mountainous quantities of goods until the very ages of time began to overflow with our production. We placed our goods on a credit basis similar to that which abounds among you primitives except for longer terms and no interest. Still it ballooned until all of history was in debt to us. Abruptly, the government was forced to order curtailment of further credit sales for fear of causing complete economic chaos in the territories, with consequent repercussions in our own times due to time stream linkage.

"That's the dilemma that faced the present Commercial Age. Depression has hit us. Idlers by the millions are impoverished in mind and body for want of something to do. Their rate of consumption is insignificant beside the productive capacity they have built up. It is a case of either find new markets or face collapse in our own age."

"A case of self-preservation," said Billop.

"Exactly. So the only remaining thing was to open the Barbaric Age to our commerce. My father was opposed, as were all the other Commercialists. So I was forced to take a cargo of goods without permission and try the experiment of establishing a store here. I found that a tremendous market

exists. But I have been forced to come in ignorance of most of your mores. From history and records available in the twenty-eighth century I gained some knowledge of your language and dress and learned that you are in the midst of one of your futile wars which certainly justifies your designation as primitives. Your need of goods is great. Two special items not known among us have been produced for your special needs on my recommendation, the gas and tires. The Laundriers and Coolservers were designed to serve the Boundary store so you are getting something far ahead of your own times, however, we will have to modify these to conform more with contemporary engineering. You mentioned the two-way nuts and bolts. We don't like them either, but that's a craze that got started about 2700 and hung on for nearly a century before bolts were done away with completely as fastenings."

"This distortion of OPA to Hoppa—it interests me," said Billop. "You expected opposition correctly. What does history say about us?"

"Little. It merely outlines the depravities and barbarisms of your cult. It records how the primitive commercialists of the day require, for example, purchasers of new clothing to cut off a piece and destroy as a sacrifice to your pagan gods."

George Billop stared, then was about to burst into laughter, but some kind premonition forced him to hold it in. Certainly history had pasted them a good one for that trouser cuff deal—labeling them religious fanatics forcing sacrifices of clothing to pagan gods.

Well, they deserved it for that one, he thought.

"Then there are records," Targ continued, "of the terrible atrocities committed against men who merely dared purchase bread that had been broken. Apparently this type of bread was not under your control and you punished those who patronized commercialists not obeying your edicts. There is further record of those who were forced to walk the streets naked because they could only afford to buy a portion of a suit of clothes instead of the entire garb as you required."

Billop had recovered his composure now and nodded soberly. "History has been temperate in its record. From it I am sure, however, that you can see the power that we have in the lives of the people of the Barbaric Age."

"We had a parallel experience in the early days of the Commercial Age," said Targ. "One of our ambitious men went back even farther than this and encountered the Inquisition, an organization similar to yours. We gave up trying to establish a branch there, but I am not yet convinced that we cannot operate here. It is for you to say, but I warn you that we are prepared to defend ourselves and our property. Give us the right to operate, and we will observe your mores."

"I'm not the final judge, but I'll take your case to the chief. We

have existed for many decades. We are firmly entrenched and our power is great as your histories have proven. We shall operate for many centuries to come, as I'm sure you will find. We are satisfied with the control that we have, and the results of it. Personally, I can see no reason at all for allowing you to do business with us."

"You will obtain a decision for me, however?" said Targ.

Billop rose. "I'll get you a decision. By this afternoon."

He went out into the sunlight. He told himself he hadn't been dreaming. It was a warm morning and the dust of the unpaved street was rising in a brown haze. Everything was real. He looked back. Targ was still standing in the doorway.

Billop went down the street towards his car.

No, he hadn't been dreaming, but the story he had just heard was one that George Billop would never repeat to a living soul. He knew the story was true. The alien techniques proved it. But he also knew what would happen if he tried to tell what he had heard.

He tried to reason it out as he left Leeville. On the face of it, Targ's coming was a good thing. In a war-impoverished world it should be wonderful to have the merchandise that Targ offered. But was it? The question haunted Billop's mind. The more he thought of it, the more certain he was that Targ's coming was no unmixed blessing.

Targ's own words had indicated the fate of other ages—such extreme debt to the Commercialists that catastrophe threatened if it were expanded any more.

And that, in turn, implied that the Commercialists had become a virtual monopoly in the ages in which they established sales territories. Contemporary products were forced off the market. Unemployment resulted and indebtedness to the Commercialists grew. And then the point of saturation came when the indebtedness could be increased no further and purchasing power vanished.

That would be the ultimate fate of the twentieth century if the Commercialists gained a foothold. Yes, their products were needed now, but in the postwar period they would destroy any chance of peacetime recovery of industry.

Their engineering was so far in advance of that of the twentieth century that it was inconceivable. The Laundriers, as marvelous as they were had been prepared for export to the Boundary store adjacent to the Barbarian Age. With little effort, the Commercialists' engineers could design products to squeeze out all contemporary competition.

The conclusion was inescapable. The Commercialists must go. Targ must be filled with such fear of the Barbaric Age that he would inspire his fellows with a mortal fear of ever attempting to open a territory in the Barbaric Age again.

And how to do that?

Billop laughed a little as he drove

at the head of a long stream of cars trying vainly to pass his doddering thirty-five mile speed. What a science-fiction set-up, he thought. Harold would write it up with his hero quickly fashioning a four dimensional space spiral from an old vacuum tank and sending Targ and his outfit merrily spiraling along it throughout the ages to come.

Or perhaps he would use an atom pistol made from an eye dropper and an old UX-199 tube, powered by a C battery, and burn Targ on the spot.

But none of that would do now. This was science without fiction. A science so great that it was deadly.

Billop had no atom pistols or flame blasters and no chance of concocting one before the problem had to be solved. But he felt equally sure that Targ did possess a flame blaster or some similarly effective weapon for emergency use.

Only his bare hands—and an equally bare brain—was what Billop found he had to figure out a way to drive out the greatest menace that had ever beset civilization. For he was certain that the cumulative destructive power of invasion by the Commercialists could not be matched even by the destruction of World War II. Unemployment, poverty, debt, illness and disease would flow in the path of the commercial invasion.

The problem grew in magnitude until he felt that his mind would break under its burden as he finally arrived at his own office. When he had promised Targ a decision by afternoon, he had considered telling the chief about it and showing him the indisputable evidence of Targ's enormous stockpile.

But that was plainly out. Billop had decided that Targ must go, but the chief would spend endless days in wonder and palavar while Targ became more firmly entrenched than ever.

Billop could, of course, simply shoot Targ. But that wouldn't solve anything. He wanted to be rid of the threat that Targ represented.

Personal violence to any of the Commercialists would be useless It was true that Targ couldn't do business with those who opposed him, but who would oppose him in the present war scarce economy? Certainly not the black market patrons flocking to his store. There would be only the government bureaus, and they would have to be manned by tens of thousands of agents if the Commercialists really went into the black market business on a large scale.

The problem was, therefore, to make the Commercialists voluntarily fold up their tents and depart.

Billop put his feet on the desk and searched through the mental file of facts he had gathered from Targ. He set them down as he might have set down the factors influencing the insurance hazards in an industrial plant he was investigating.

1. Commercialists unwarlike therefore unfamiliar with an economy based upon war conditions.

Evidenced by the fact that they come with peacetime appliances rather than weapons. (Billop considered with a shudder the possibility of Targ's discovering what a market would be available in the weapons business should he start selling advanced models to both sides. There was sufficient evidence, however, to indicate this would be utterly foreign to Targ's culture. Even the idea of rationing as a war necessity was completely alien to the Commercialists' concepts.)

2. The twentieth century was a barbaric period to the Commercialists. All deals would be on the same plane as Pilgrims bargaining with Indians.

3. Contemporary customs and mores would be strictly observed by the Commercialists as a necessary expedient to doing business.

4. The alphabet bureaus had been painted as religious fanatic groups disguising commercial terrorism.

Billop scanned the material he had written down. Somewhere there he felt was a definite solution to his problem. But it was only a feeling—

His secretary came in silently and laid the afternoon's mail on his desk. There was a complaint that Sim's grocery was charging fifteen percent above ceiling prices on a fifteen cents card of bobby pins. Billop wondered where Sims had got the pins. His wife had been trying for two months to get some. He'd have to go down there on the way home—remind Sims to check on his ceiling price, too.

The next item was also irate. This gentleman asserted that "Since I am now spending fifty-one percent of my time filling out your pink, blue, yellow, and heliotrope forms and mailing them to Washington, Denver, San Francisco and points east, and am spending only forty-nine percent of my time doing productive work in my business that makes you controlling stockholder. Therefore, you can have the joint. I'm quitting."

Billop scowled heavily. He'd have to go out and have a talk with the guy. Probably it was a good little business—if the guy would just hang on a little longer. Every time a new batch of forms was released to be filled out in triplicate, quadruplicate, and umpteenthlicate Billop said a prayer for the little guys that had to fill them out.

Anyway, that wasn't getting the business of Targ & Son taken care of.

Or was it?

He sat up suddenly and stared at the pile of notes and added one more:

5. The Commercialists do not give receipts.

Why had he failed to see the implication of that before? Obviously, Commercialists of thirty centuries advancement over the twentieth century would have their procedures stripped down to an efficient minimum. All the nonsensical paper work that so begummed the wheels of contemporary commerce would be done away with. Single, simple, unalterable, centrally located records undoubt-

edly would make efficient note of transactions, eliminating the great overhead of hand-inscribed receipts, bills, notices, forms, and assorted paper waste.

What if a stripped down commercial organization like that were plunged into a morass of bureaucratic paper? He thought of the little groceryman, Smith, plowing through the fog of OPA instructions in the night hours and in the end having to confess a felony for two cents. But perhaps the sacrifice of Smith's honor would not be in vain.

Billop returned to Leeville late that afternoon. In the back of his car were thousands of polychrome forms from a dozen agencies.

Targ apparently had been waiting for him with some anxiety. "You have a decision for us?"

"Yes," Billop smiled pleasantly. "The chief said it would be O.K. for you to go ahead, but you've got to conform to every regulation. If you don't, we'll forbid anyone to make purchases here."

"We'll conform, I assure you. Explain your regulations."

"I have a few forms you are required to fill out. Will you send a couple of men to help me unload them from the car?"

Two of Targ's clerks began carrying in the assorted forms under Billop's direction. Dismay crept over Targ's face as he viewed the mounting, polychrome pile.

"I don't understand," he said.

"Well, it will take quite a bit of background to understand this so we may as well get to work." Billop removed his coat and lighted a cigar that tasted like tarred rope. But Targ's distaste was obvious, so it was worth it to Billop.

Billop picked up a gem of the bureaucratic art. It was a nine-copy form made in three accordian sections with carbon assembled. Four colors and five variant shades provided identification.

"This is the one you fill out every time you sell a Laundrier," said Billop. "Most of it is self-explanatory. Name of firm, that's you, address and all that sort of thing. Now here on the second page we begin to get into the meat of the thing. You are required to list the name and address of the purchaser, the use to which the Laundrier is to be put."

"That's obvious," said Targ. "It's to cleanse and finish clothing or other dry goods articles."

"O.K. That goes on the form then. The next line calls for an explanation of why the purchaser needs the device. In order to fill out this section you need to know what equipment the Laundrier is replacing, the date of purchase of the original equipment and the reason why it cannot continue to do service!"

"We'll need a research organization to fill that out!"

"Well, you said that was one of your major items of overhead. Since you have such a complete organization I should think it would be very easy for you to take care of these simple forms."

"But what possible purpose can all of this serve!"

"We have to know the origin and destination of every bolt, wire, and piece of tin that is sold by any distributor. We have to know the relative urgency of its need in order not to glut the market. These forms provide us with information enabling us to control the flow of goods so that such a condition as you have brought about in other ages could not occur here, either through our activities or yours. We control consumption at the point of use."

"And penalize the consumer for violation?"

"Right. Your histories have spoken of the token sacrifices required in connection with clipping articles of clothing. That is a sample of the methods by which we maintain control. Very effective, too."

"If we didn't need your market so badly—"

Billop shrugged. "It's up to you. Do business our way or you don't do business."

Immediately Targ became all smiles again. Billop suspected that Salesman's Smile must be part of the training of all export salesmen from the Commercial Age.

"We'll do business your way, of course," said Targ. "Our cardinal principle—"

"—is to follow the contemporary mores of the age in which you operate. Now, this form here—"

Billop picked up another sample multihued and patented so that no one else would steal its unique complexity.

Through the late evening hours and on past midnight Billop peeled off one form after another.

Form 1036A, four copies to Washington—

The pink and the blue to San Francisco—

The orange and the heliotrope to Kansas City—

The white copy to file—

The green to the customer—

Billop made out an elaborate chart showing the routing of the twenty-five separate forms he left with Targ. In addition, he piled copies of assorted alphabet bureau regulations on the desk, especially those fashioned after the style of that masterful mouthful concerning the "extinguishment of the illumination", and the twenty thousand word opus on how to cut a steak off a cow.

When he left in the dark hours of dawn he felt fully satisfied. Targ had been impressed by the lavish display of "barbarism", as he frankly termed it. And he would attempt to follow Billop's instructions to the letter. The rigid code of the Commercialists would assure that. In the end, the inefficiency of the whole business would force Targ to return to his own age or break the contemporary customs.

Billop felt that Targ would return.

He only hoped that Targ didn't discover that the eight forms covering Laundriers had been printed to cover washers, gate valves, electric heaters, mechanical milkers, and flat irons.

Billop was not counting on Targ's being a fool, but on two principles

he would succeed or fail. One was Targ's thorough indoctrination with the historical misconception of the alphabet bureaus, the second was the idea that in order to be successful the contemporary mores of any age must be observed to the letter.

The latter fact, Billop hoped, would keep Targ from delving too closely into the forms and trying to make sense out of them. He was thankful now for the numerous bright young men struggling away in little offices to conceive new rainbow hued monstrosities, thankful that they didn't worry too much about making themselves clear.

As the sunrise began to glow in the east George Billop thought it was the most beautiful color in the world.

The color of red tape.

Forms from Targ began to flow in the next day—along with the results of the Leeville ration board's telegram to Washington.

The chief called Billop into the inner sanctum.

"Just got a wire from Washington. There's news of some big black market outfit operating in Leeville. Nothing but a wide spot in a couple of cross roads. Personally, I don't think it's very important. It doesn't seem likely that a very big outfit could be operating from a little burg like that. But Washington wants a man on it. Hate to ask you to spend time on it but maybe it won't take long to clear up."

This was a totally unexpected break. With a little luck now he'd have a free hand with Targ.

"I'm sure I can take care of it," Billop said. "I'll get on it now."

He went back to his office and checked over the forms that Targ had sent in. The Commercialists

were certainly trying to do a conscientious job of filling them out. What a joy life would be for the income tax people, Billop thought, if they were operating in the Commercial Age.

He estimated three days of this would bring a crisis. Targ's culture couldn't allow him to hold out for long. But the forms came dutifully along, perfectly filled out.

It was this perfection that worried Billop. Targ was too smart to be fooled long. It would be only a matter of days until he became sufficiently acquainted with local conditions and current affairs to know that the histories had erred. Then he would know there were no such controls as Billop had boasted. He would know he could have a free reign after the war, if not now.

Billop sent him another load of forms by mail and returned a number for insignificant errors to keep Targ on his toes.

It was on the fourth day of this that he received a phone call from Targ. The Commercialist's voice was as implacable as ever but what he said showed there was plenty of sand in the gears.

"We aren't doing any business," said Targ. "All we're doing is spending our time filling out your forms. We've had to get five times our previous staff here and we're doing one twentieth the business. We can't continue this way."

"I'm so sorry," said Billop. "Others are successfully operating under the same regulations."

"But your operations are totally irrational."

"Credit that to our barbarism. It's the way we like it."

"But I can't sell an item without a slip from the so-called ration board here in this town."

"That's right."

"But the ration board won't issue enough slips. There are only an insignificant number that are of no commercial consequence."

"That's according to our principles of controlled consumption."

"Then there's a tremendous market that you are not filling! That's more than primitive. That's stupid," Targ exploded.

"Perhaps you would find your operations more suited to another age," said Billop stiffly—and hopefully.

"No! This is the greatest opportunity we've ever had. I've never seen such a market as this. People are clamoring for the goods we have. And your stupid customs won't allow them to be satisfied. I rebelled against my own age in coming here in the first place. And now I'm going to rebel again. I'm going to stop obeying such stupid regulations as you have set up."

"We'll take your market away."

"I will be interested in observing your methods of doing so."

He hung up. For a long time George Billop continued to hold the phone and stare into the black mouthpiece. He hadn't counted on this. He had made a terrible misjudgment in not taking into account that Targ must be a great rebel in his own times as evidenced by his

daring to come past the Boundary Age at all.

And now this rebellion was causing him to throw overboard another of the cherished standards of the Commercialists. He didn't believe Billop had the power he claimed and was going to defy it.

Billop pondered on what he should do. He could throw the whole ponderous machinery of government into gear now. It would stop Targ for a time, but wouldn't insure the post war world against invasion by the Commercialists. There had to be some other way. A drastic, desperate way that would hurl Targ back to his own time. Billop had tried to be subtle. But it was time now for direct action.

He went out to his car and drove to Leeville. There, he looked up the one-room newspaper office. A bewhiskered pressman looked up from the inky depths of the press in which he was probing with a monkey wrench. "Yes?" he said.

Billop said. "I'm from the OPA. I guess you know why I'm here."

"It's about time you showed up. I'm just setting up a nice hot editorial on the scandalous situation in this black market town. Going to crack down on them good? Maybe I better hold off on my editorial."

"I think it would be a good idea," Billop answered. "I want you to help me. Every person that has bought a black market article from Targ is just as liable under the law as he is. Now, you're pretty familiar with everyone in town. I guess you know pretty well who has new washers and refrigerators and so on from Targ's."

"Practically everyone in town has something from there."

"And they're still trading there?"

"Sure, they go in and prowl around those stacks of tires like they were made of candy."

"Can you come over to Targ's with me now?"

"Sure. Let me wash up here."

When they came to the next block, Billop saw that Targ had modified his sign above his store. It read:

Targ & Son
Black Market Mercantile

Billop grinned wryly. Targ was no fool, but three millennia difference in culture sure did help a lot.

Billop was saddened by the stream of cars still flowing towards that focus like insects darting for a flame. With Targ blatantly proclaiming alliance with one of the most destructive influences in the country, they continued to stream into the store.

Once again the gas pumps were flowing freely and tires were rolling out the door propelled by hasty customers anxious to get away more quickly now that Targ had changed his sign.

In the showroom, Targ greeted them.

"Welcome," he greeted cordially, "to Targ's Black Market. You see that we have our business back to normal. I'm sorry that it does not meet with your approval. But

when our competitors of your own age see the results of our daring to break your taboos it will be the end of the OPA, Mr. Billop."

"Within half an hour," said Billop slowly, "there won't be a customer in your store. In fact, I rather doubt that there will be a store."

Targ raised his eyebrows. "I told you we came prepared to meet violence."

"We're primitive barbarians, Targ, but we have a kind of violence I don't think you know about."

"I warn you—"

"Mind if we look around a bit? We might buy another set of tires before we put you out of business."

He moved among the crowd for a time. Their tension was at a tremendous peak. Targ's change of sign had been just the added straw. They were branded as black market patrons the moment they walked in the door and the knowledge weighed upon them. Neighbors glanced suspiciously at each other and tried to joke faintly. It was very faint. Instead of the babble of conversation he had heard before people spoke in hushed tones that puzzled Targ's salesmen. They couldn't figure it out, but the aura of uneasiness spread and they were made uncomfortable by it.

Their salesman's smiles looked a trifle worried to Billop and it was a very good sign.

"Who are some of these people?" Billop asked Melgroth, the newspaperman, as they moved back away from the crowd.

"Well, there's Mrs. Barker over there by the Laundriers. She's already bought one. Must want to send one away—or else have a spare on hand in case that one breaks down."

"Any of her family overseas?"

"Son on Tarawa. He never left there."

"Who's the man by the tires?"

One by one the newsman pointed out the citizens of the town, and told Billop something of their personal history and their stakes in the war.

After twenty minutes Billop was ready. The store was filled with noontime shoppers and tension was at a peak. Even Targ had come out of his office once or twice, peering about with a worried look on his face as if trying to fathom the emotional depths of the primitives he had come to deal with.

Billop stepped to the front door and closed it slowly. Then he stood there with his back against it and watched the interior of the store.

Someone looked up and saw him standing there staring. Someone else glanced up and was held by the look on Billop's face. One by one they grew silent. A man moved towards the door to go out.

"I'm from the OPA," said Billop quietly. "I'd like to talk with you folks."

The man nearest the door blanched. "We haven't done anything. I've turned in ration certificates for everything I've got."

"Except the gas," said Billop. "Let's see, you're Stannard, aren't you? Your son, Bob is in the Pacific. I wonder if he knows his

dad's riding around on gas he needs so badly down there. Think so?"

"But I didn't—"

"Mrs. Barker, that's a wonderful washer, that Laundrier, isn't it? Ever stop to think that the time and materials involved in it would have made a gun that Dick needed badly that day he met the Japs?"

"Stop it!" The woman's sudden, hysterical sob pierced the room.

"It's brutal when it comes home to roost, isn't it, folks? You wouldn't have accepted a Nazi gun with orders to turn it on your own husband would you, Mrs. Beal? But you let this man Targ take the gun away from your husband and turn it into a refrigerator, a gun that Joe needed badly to defend himself."

"You cruel . . . I didn't know. I didn't think—"

"That's the trouble with all of us, isn't it?" said Billop sadly. "We don't think, and then someone takes advantage of it and we're in a jam."

Targ now appeared at the rear and was puzzled and tense. He had never experienced anything like the surging emotion that could be felt in the air. He was reaching out mentally with all the attainments of his millennium old culture, trying to fathom the motives of these barbarians, but his mind was incapable of grasping it with the slim threads of evidence he possessed.

He had not heard Billop's first words. Billop had purposely waited until Targ was away, because he knew his words could give Targ dangerous clues.

But now he pointed towards the Commercialist. "You didn't stop to think that when this man came into your midst and offered you so freely the appliances and supplies you wanted so much that he was offering you the supplies your men also needed so badly—in another form.

"He put the guns in your hands —and you fired the bullets—right in the backs of—"

There was a hysterical shriek from someone at the rear of the showroom. A man leaped toward Targ and another one yelled, "Get him!"

Quickly, Billop opened the door and slipped out. His work was done. He had triggered the near-explosive emotion built up in the crowd and now it was a mob with fury turned upon their supposed benefactor. That was a transition that Targ would never succeed in comprehending, Billop hoped.

For Billop didn't comprehend it himself, he knew. Yet he had felt sure that there would be enough emotion in the crowd to trigger into mob fury, and he had been right. But he was saddened by the weakness of human nature.

Targ, on his part, had been totally unprepared for that kind of attack. He had thought it would be something as subtle as a thought wave, or as sudden as an atom blast. He was prepared for those, but not for the sudden surge of beating fists and tearing hands.

The pandemonium grew in the

store and Billop found himself alone as he walked away. The newspaperman had been lost somewhere. Probably covering the story. Billop wondered how much of a story there would be to cover.

Billop hoped fervently that Targ or some of his staff would escape back to the Commercial Age to spread the word of the terror that existed in the Barbarian Era. It was important that the word get back.

When he got to the car, Billop halted. Surges of flame were rising from the store. The mob was pouring out the door now amid billowing smoke. Saddened, Billop hoped that few would be hurt. He wondered if perhaps he had made a mistake, if he could have acted differently, less brutally. He knew he could not with the fate of the century at stake.

The menace that Targ represented was subtle as disease, but terrible as war.

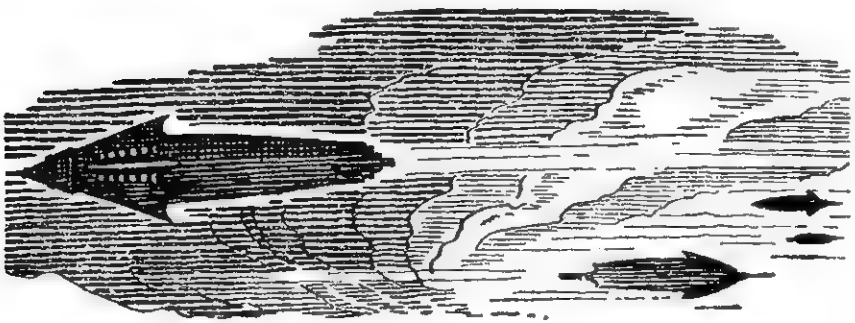
The mob had swarmed from the burning building, but Targ was nowhere to be seen. Billop wondered what had become of him, when suddenly the entire burning structure seemed to grow faintly transparent. The flames became a ghostly glow in the sunlight. With a shock Billop suddenly realized the thing was gone. Only an empty space and brands burning on adjacent roofs marked the site of Targ's Black Market.

So Targ or someone of his staff had made good an escape. Word would be carried back. Billop had the feeling that the Commercialists would not venture back into the Barbaric Age.

The brands on the roofs were burning more fierly now, but Leeville's lone fire engine was clanging down the street. The engine was a nice color, Billop thought, and so were the flames. The color that had brought on the crisis and laid the groundwork for Targ's defeat. The nicest color in the world.

The color of red tape.

THE END.



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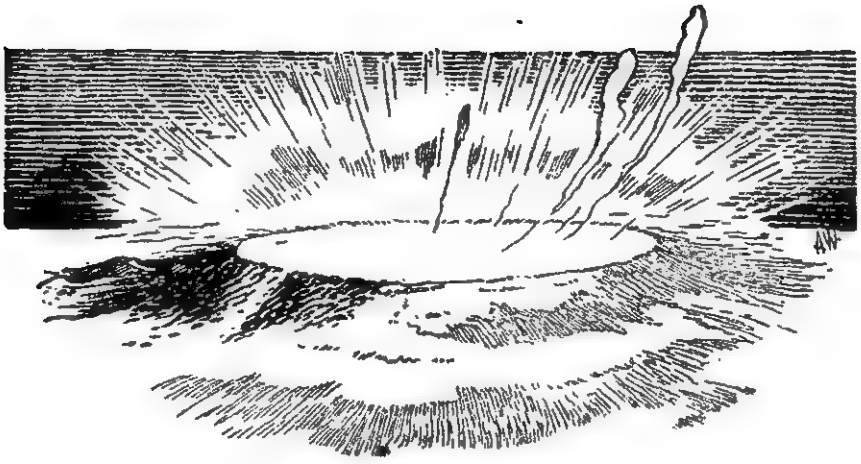

Memorial

by THEODORE STURGEON

His plan was to create a crater that would warn all men to avoid atomic war for five thousand years to come, memorial that would spit lava and deadly rays for five millenniums. Part of his plan was fulfilled—the wrong part.

Illustrated by Williams

The Pit, in A.D. 5000, had changed little over the centuries. Still it was an angry memorial to the misuse of great power; and because of it, organized warfare was a forgotten thing. Because of it, the world was free of the wasteful smoke and dirt of industry. The scream and crash of bombs and the soporific beat of marching feet were never heard, and at long last the earth was at peace.

To go near The Pit was slow, certain death, and it was respected and feared, and would be for centuries more. It winked and blinked redly at night, and was surrounded by a bald and broken tract stretching out and away over the horizon; and around it flickered a ghostly blue glow. Nothing lived there. Nothing could.

With such a war memorial, there could only be peace. The earth could never forget the horror that could be loosed by war.

That was Grenfell's dream.

Grenfell handed the typewritten sheet back. "That's it, Jack. My idea, and—I wish I could express it like that." He leaned back against the littered workbench, his strangely asymmetrical face quizzical. "Why is it that it takes a useless person to adequately express an abstract?"

Jack Roway grinned as he took back the paper and tucked it into his breast pocket. "Interestin' question, Grenfell, because this *is* your expression, the words *are* yours. Practically verbatim. I left out the 'er's' and 'Ah's' that you play conversational hopscotch with, and strung together all the effects you mentioned without mentioning any of the technological causes. Net result: you think I did it, when you did. You think it's good writing, and I don't."

"You don't?"

Jack spread his bony length out on the hard little cot. His relaxation was a noticeable act, like the unbuttoning of a shirt collar. His body seemed to unjoint itself a little. He laughed.

"Of course I don't. Much too emotional for my taste. I'm just a fumbling aesthete—useless, did you say? Mm-m-m—yeah. I suppose so." He paused reflectively. "You see, you cold-blooded characters, you scientists, are the true visionaries. Seems to me the essential difference between a scientist and an artist is that the scientist mixes his hope with patience.

"The scientist visualizes his ultimate goal, but pays little attention to it. He is all caught up with the achievement of the next step upward. The artist looks so far ahead that more often than not he can't see what's under his feet; so he falls flat on his face and gets called useless by scientists. But if you strip all of the intermediate steps away from the scientist's thinking, you have an artistic concept to which the scientist responds distantly and with surprise, giving some artist credit for being deeply perspicacious purely because the artist repeated something the scientist said."

"You amaze me," Grenfell said candidly. "You wouldn't be what you are if you weren't lazy and superficial. And yet you come out with things like that. I don't know that I understand what you just said. I'll have to think—but I do believe that you show all the signs of clear thinking. With a mind like yours, I can't understand why you don't use it to build something instead of wasting it in these casual interpretations of yours."

Jack Roway stretched luxuriously. "What's the use? There's more waste involved in the destruction of something which is already built than in dispersing the energy it would take to help build something. Anyway, the world is filled with builders—and destroyers. I'd just as soon sit by and watch, and feel things. I like my environment, Grenfell. I want to feel all I can of it, while it lasts. It won't last much longer. I want to touch all of it I can reach, taste of it, hear it, while there's time. What is around me,

here and now, is what is important to me. The acceleration of human progress, and the increase of its mass—to use your own terms—are taking humanity straight to Limbo. You, with your work, think you are fighting humanity's inertia. Well, you are. But it's the kind of inertia called momentum. You command no force great enough to stop it, or even to change its course appreciably."

"I have atomic power."

Roway shook his head, smiling. "That's not enough. No power is enough. It's just too late."

"That kind of pessimism does not affect me," said Grenfell. "You can gnaw all you like at my foundations, Jack, and achieve nothing more than the loss of your front teeth. I think you know that."

"Certainly I know that. I'm not trying to. I have nothing to sell, no one to change. I am even more impotent than you and your atomic power; and you are completely helpless. Uh—I quarrel with your use of the term 'pessimist', though. I am nothing of the kind. Since I have resolved for myself the fact that humanity, as we know it, is finished, I'm quite resigned to it. Pessimism from me, under the circumstances, would be the pessimism of a photophobiac predicting that the sun would rise tomorrow."

Grenfell grinned. "I'll have to think about that, too. You're such a mass of paradoxes that turn out to be chains of reasoning. Apparently you live in a world in which scientists are poets and the grasshopper has it all over the ant."

"I always did think that ant was a stinker."

"Why do you keep coming here, Jack? What do you get out of it? Don't you realize I'm a criminal?"

Roway's eyes narrowed. "Sometimes I think you wish you were a criminal. The law says you are, and the chances are very strong that you'll be caught and treated accordingly. Ethically, you know you're not. It sort of takes the spice out of being one of the hunted."

"Maybe you're right," Grenfell said thoughtfully. He sighed. "It's so completely silly. During the war years, the skills I had were snatched up and the government flogged me into the Manhattan Project, expecting, and getting, miracles. I have never stopped working along the same lines. And now the government has changed the laws, and pulled legality from under me."

"Hardly surprising. The government deals rather severely with soldiers who go on killing other soldiers after the war is over." He held up a hand to quell Grenfell's interruption. "I know you're not killing anyone, and are working for the opposite result. I was only pointing out that it's the same switcheroo. We the people," he said didactically, "have, in our sovereign might, determined that no atomic research be done except in government laboratories. We have then permitted our politicians to allow so little for maintenance of those laboratories—unlike our overseas friends—that no really exhaustive research can be done in

them. We have further made it a major offense to operate such a bootleg lab as yours." He shrugged. "Comes the end of mankind. We'll get walloped first. If we put more money and effort into nuclear research than any other country, some other country would get walloped first. If we last another hundred years—which seems doubtful—some poor, spavined, underpaid government researcher will stumble on the aluminum-isotope space-heating system you have already perfected."

"That was a little rough," said Grenfell bitterly. "Driving me underground just in time to make it impossible for me to announce it. What a waste of time and energy it is to heat homes and buildings the way they do now! Space heating—the biggest single use for heat-energy—and I have the answer to it over there." He nodded toward a compact cube of lead-alloys in the corner of the shop. "Build it into a foundation, and you have controllable heat for the life of the building, with not a cent for additional fuel and practically nothing for maintenance." His jaw knotted. "Well, I'm glad it happened that way."

"Because it got you started on your war memorial— The Pit? Yeah. Well, all I can say is, I hope you're right. It hasn't been possible to scare humanity yet. The invention of gunpowder was going to stop war, and didn't. Likewise the submarine, the torpedo, the airplane, and that two-by-four bomb they pitched at Hiroshima."

"None of that applies to The Pit," said Grenfell. "You're right; humanity hasn't been scared off war yet; but the Hiroshima bomb rocked 'em back on their heels. My little memorial is the real stuff. I'm not depending on a fission effect, you know, with a release of one-tenth of one percent of the energy of the atom. I'm going to disrupt it completely, and get all the energy there is in it. And it'll be *more* than a thousand times as powerful as the Hiroshima bomb, because I'm going to use twelve times as much explosive; and it's going off on the ground, not a hundred and fifty feet above it." Grenfell's brow, over suddenly hot eyes, began to shine with sweat. "And then—The Pit," he said softly. "The war memorial to end war, and all other war memorials. A vast pit, alive with bubbling lava, radiating death for ten thousand years. A living reminder of the devastation mankind has prepared for itself. Out here on the desert, where there are no cities, where the land has always been useless, will be the scene of the most useful thing in the history of the race—a never-ending sermon, a warning, an example of the dreadful antithesis of peace." His voice shook to a whisper, and faded.

"Sometimes," said Roway, "You frighten me, Grenfell. It occurs to me that I am such a studied sensualist, tasting everything I can, because I am afraid to feel any one thing that much." He shook himself, or shuddered. "You're a fanatic, Grenfell. Hyperemotional. A monomaniac. I hope you can do it."

"I can do it," said Grenfell.

Two months passed, and in those two months Grenfell's absorption in his work had been forced aside by the increasing pressure of current events. Watching a band of vigilantes riding over the waste to the south of his little buildings one afternoon, he thought grimly of what Roway had said. "Sometimes I think you wish you were a criminal." Roway, the sensualist, would say that. Roway would appreciate the taste of danger, in the same way that he appreciated all the other emotions. As it intensified, he would wait to savor it, no matter how bad it got.

Twice Grenfell shut off the instigating power of the carbon-aluminum pile he had built, as he saw government helicopters hovering on the craggy skyline. He knew of hard-radiation detectors; he had developed two different types of them during the war; and he wanted no questions asked. His utter frustration at being unable to announce the success of his space-heating device, for fear that he would be punished as a criminal and his device impounded and forgotten — that frustration had been indescribable. It had canalized his mind, and intensified the devoted effort he had put forth for the things he believed in during the war. Every case of neural shock he encountered in men who had been hurt by war and despised it, made him work harder on his monument—on The Pit. For if humans could be frightened by war, humanity could be frightened by The Pit.

And those he met who had been hurt by war and who still hated the late enemy—those who would have been happy to go back and kill some more, reckoning vital risk well worth it—those he considered mad, and forgot them.

So he could not stand another frustration. He was the center of his own universe, and he realized it dreadfully, and he had to justify his position there. He was a humanitarian, a philanthropist in the word's truest sense. He was probably as mad as any other man who has, through his own efforts, moved the world.

For the first time, then, he was grateful when Jack Roway arrived in his battered old convertible, although he was deliriously frightened at the roar of the motor outside his laboratory window. His usual reaction to Jack's advent was a mixture of annoyance and gratification, for it was a great deal of trouble to get out to his place. His annoyance was not because of the interruption, for Jack was certainly no trouble to have around. Grenfell suspected that Jack came out to see him partly to get the taste of the city out of his mouth, and partly to be able to feel superior to somebody he considered of worth.

But the increasing fear of discovery, and his race to complete his work before it was taken from him by a hysterical public, had had the unusual effect of making him lonely. For such a man as Grenfell to be lonely bordered on the extraordinary; for in his daily life there were simply too many things to be done. There had never been enough hours

in a day nor days in a week to suit him, and he deeply resented the encroachments of sleep, which he considered a criminal waste.

"Roway!" he blurted, as he flung the door open, his tone so warm that Roway's eyebrows went up in surprise. "What dragged you out here?"

"Nothing in particular," said the writer, as they shook hands. "Nothing more than usual, which is a great deal. How goes it?"

"I'm about finished." They went inside, and as the door closed, Grenfell turned to face Jack. "I've been finished for so long I'm ashamed of myself," he said intently.

"Ha! Ardent confession so early in the day! What are you talking about?"

"Oh, there have been things to

do," said Grenfell restlessly. "But I could go ahead with the . . . with the big thing at almost any time."

"You hate to be finished. You've never visualized what it would be like to have the job done." His teeth flashed. "You know, I've never heard a word from you as to what your plans are after the big noise. You going into hiding?"

"I . . . haven't thought much about it. I used to have a vague idea of broadcasting a warning and an explanation before I let go with the disruptive explosion. I've decided against it, though. In the first place, I'd be stopped within minutes, no matter how cautious I was with the transmitter. In the second place—well, this is going to be so big that it won't need any explanation."

"No one will know who did it, or why it was done."

"Is that necessary?" asked Grenfell quietly.

Jack's mobile face stilled as he visualized The Pit, spewing its ten-thousand-year hell. "Perhaps not," he said. "Isn't it necessary, though, to you?"

"To me?" asked Grenfell, surprised. "You mean, do I care if the world knows I did this thing, or not? No; of course I don't. A chain of circumstance is occurring, and it has been working through me. It goes directly to The Pit; The Pit will do all that is necessary from then on. I will no longer have any part in it."

Jack moved, clinking and splashing, around the sink in the corner of the laboratory. "Where's all your coffee? Oh—here. Uh . . . I have been curious about how much personal motive you had for your work. I think that answers it pretty well. I think, too, that you believe what you are saying. Do you know that people who do things for impersonal motives are as rare as fur on a fish?"

"I hadn't thought about it."

"I believe that, too. Sugar? And milk. I remember. And have you been listening to the radio?"

"Yes. I'm . . . a little upset, Jack," said Grenfell, taking the cup. "I don't know where to time this thing. I'm a technician, not a Machiavelli."

"Visionary, like I said. You don't know if you'll throw this gadget of yours into world history too soon or too late—is that it?"

"Exactly. Jack, the whole world seems to be going crazy. Even fission bombs are too big for humanity to handle."

"What else can you expect," said Jack grimly, "with our dear friends across the water sitting over their push buttons waiting for an excuse to punch them."

"And we have our own set of buttons, of course."

Jack Roway said: "We've got to defend ourselves."

"Are you kidding?"

Roway glanced at him, his dark brows plotting a V. "Not about this. I seldom kid about anything, but particularly not about this." And he—shuddered.

Grenfell stared amazedly at him and then began to chuckle. "Now,"

he said, "I've seen everything. My iconoclastic friend Jack Roway, of all people, caught up by a . . . a fashion. A national pastime, fostered by uncertainty and fed by yellow journalism—fear of the enemy."

"This country is not at war."

"You mean, we have no enemy? Are you saying that the gentlemen over the water, with their itching fingertips hovering about the push-buttons, are not our enemies."

"Well—"

Grenfell came across the room to his friend, and put a hand on his shoulder. "Jack—what's the matter? You can't be so troubled by the news—not *you!*"

Roway stared out at the brazen sun, and shook his head slowly. "International balance is too delicate," he said softly; and if a voice could glaze like eyes, his did. "I see the nations of the world as masses balanced each on its own mathematical point, each with its center of gravity directly above. But the masses are fluid, shifting violently away from the center lines. The opposing trends aren't equal; they can't cancel each other; the phasing is too slow. One or the other is going to topple, and then the whole works is going to go."

"But you've known that for a long time. You've known that ever since Hiroshima. Possibly before. Why should it frighten you now?"

"I didn't think it would happen so soon."

"Oh-ho! So that's it! You have suddenly realized that the explosion is going to come in your lifetime. Hm-m-m? And you can't take that. You're capable of all of your satisfying aesthetic rationalizations as long as you can keep the actualities at arm's length!"

"Whew!" said Roway, his irrepressible humor passing close enough to nod to him. "Keep it clean, Grenfell! Keep your . . . your sesquipedalian polysyllabics for a scientific report."

"Touché!" Grenfell smiled. "Y'know, Jack, you remind me powerfully of some erstwhile friends of mine who write science-fiction. They had been living very close to atomic power for a long time—years before the man on the street—or the average politician, for that matter—knew an atom from Adam. Atomic power was handy to these specialized word-merchants because it gave them a limitless source of power for background to a limitless source of story material. In the heyday of the Manhattan Project, most of them suspected what was going on, some of them knew—some even worked on it. All of them were quite aware of the terrible potentialities of nuclear energy. Practically all of them were scared silly of the whole idea. They were afraid for humanity, but they themselves were not really afraid, except in a delicious drawing room sort of way, because they couldn't conceive of this Buck Rogers event happening to anything but posterity. But it happened, right smack in the middle of their own sacrosanct lifetimes.

"And I will be dog-goned if you're not doing the same thing. You've gotten quite a bang out of

figuring out the doom humanity faces in an atomic war. You've consciously risen above it by calling it inevitable, and in the meantime, leave us gather rosebuds before it rains. You thought you'd be safe home—dead—before the first drops fell. Now social progress has rolled up a thunderhead and you find yourself a mile from home with a crease in your pants and no umbrella. And you're scared!"

Roway looked at the floor and said, "It's so soon. It's so soon." He looked up at Grenfell, and his cheekbones seemed too large. He took a deep breath. "You . . . we can stop it, Grenfell."

"Stop what?"

"The war . . . the . . . this thing that's happening to us. The explosion that will come when the strains get too great in the international situation. And it's *got* to be stopped!"

"That's what The Pit is for."

"The Pit!" Roway said scornfully. "I've called you a visionary before. Grenfell, you've got to be more practical! Humanity is not going to learn anything by example. It's got to be kicked and carved. Surgery."

Grenfell's eyes narrowed. "Surgery? What you said a minute ago about my stopping it . . . do you mean what I think you mean?"

"Don't you see it?" said Jack urgently. "What you have here—total disruptive energy—the peak of atomic power. One or two wallops with this, in the right place, and we can stop anybody."

"This isn't a weapon. I didn't make this to be a weapon."

"The first rock ever thrown by a prehistoric man wasn't made to be a weapon, either. But it was handy and it was effective, and it was certainly used because it had to be used." He suddenly threw up his hands in a despairing gesture. "You don't understand. Don't you realize that this country is likely to be attacked at any second—that diplomacy is now hopeless and helpless, and the whole world is just waiting for the thing to start? It's probably too late even now—but it's the least we can do."

"What, specifically, is the least thing we can do?"

"Turn your work over to the War Department. In a few hours the government can put it where it will do the most good." He drew his finger across his throat. "Anywhere we want to, over the ocean."

There was a taut silence. Roway looked at his watch and licked his lips. Finally Grenfell said, "Turn it over to the government. Use it for a weapon—and what for? To stop war?"

"Of course!" blurted Roway. "To show the rest of the world that our way of life . . . to scare the daylights out of . . . to—"

"*Stop it!*" Grenfell roared. "Nothing of the kind. You think—you hope anyway—that the use of total disruption as a weapon will stall off the inevitable—at least in your lifetime. Don't you?"

"No. I—"

"Don't you?"

"Well, I—"

"You have some more doggerel to write," said Grenfell scathingly. "You have some more blondes to chase. You want to go limp over a few more Bach fugues."

Jack Roway said: "No one knows where the first bomb might hit. It might be anywhere. There's nowhere I . . . we . . . can go to be safe." He was trembling.

"Are the people in the city quivering like that?" asked Grenfell.

"Riots," breathed Roway, his eyes bright with panic. "The radio won't announce anything about the riots."

"Is that what you came out here for today—to try to get me to give disruptive power to *any* government?"

Jack looked at him guiltily. "It was the only thing to do. I don't know if your bomb will turn the trick, but it has to be tried. It's the only thing left. We've got to be prepared to hit first, and hit harder than anyone else."

"No." Grenfell's one syllable was absolutely unshakable.

"Grenfell—I thought I could argue you into it. Don't make it tough for yourself. You've got to do it. Please do it on your own. Please, Grenfell." He stood up slowly.

"Do it on my own—or what? *Keep away from me!*"

"No . . . I—" Roway stiffened suddenly, listening. From far above and to the north came the whir of rotary wings. Roway's fear-slackened lips tightened into a grin, and with two incredibly swift strides he was across to Grenfell. He swept in a handful of the smaller's man's shirt front and held him half off the floor.

"Don't try a thing," he gritted. There was not a sound then except their harsh breathing, until Grenfell said wearily: "There was somebody called Judas—"

"You can't insult me," said Roway, with a shade of his old cockiness, "And you're flattering yourself."

A helicopter sank into its own roaring dust-cloud outside the building. Men pounded out of it and burst in the door. There were three of them. They were not in uniform.

"Dr. Grenfell," said Jack Roway, keeping his grip, "I want you to meet—"

"Never mind that," said the taller of the three in a brisk voice. "You're Roway? Hm-m-m. Dr. Grenfell, I understand you have a nuclear energy device on the premises."

"Why did you come by yourself?" Grenfell asked Roway softly. "Why not just send these stooges?"

"For you, strangely enough. I hoped I could argue you into giving the thing freely. You know what will happen if you resist?"

"I know." Grenfell pursed his lips for a moment, and then turned to the tall man. "Yes. I have some such thing here. Total atomic disruption. Is that what you were looking for?"

"Where is it?"

"Here, in the laboratory, and then

there's the pile in the other building. You'll find—" He hesitated. "You'll find two samples of the concentrate. One's over there—" he pointed to a lead case on a shelf behind one of the benches. "And there's another like it in a similar case in the shed back of the pile building."

Roway sighed and released Grenfell. "Good boy. I knew you'd come through."

"Yes," said Grenfell. "Yes—"

"Go get it," said the tall man. One of the others broke away.

"It will take two men to carry it," said Grenfell in a shaken voice. His lips were white.

The tall man pulled out a gun and held it idly. He nodded to the second man. "Go get it. Bring it here and we'll strap the two together and haul 'em to the plane. Snap it up."

The two men went out toward the shed.

"Jack?"

"Yes, Doc."

"You really think humanity can be scared?"

"It will be—now. This thing will be used right."

"I hope so. Oh, I hope so," Grenfell whispered.

The men came back. "Up on the bench," said the leader, nodding toward the case the men carried between them.

As they climbed up on the bench and laid hands on the second case, to swing it down from the shelf, Jack Roway saw Grenfell's face spurt sweat, and a sudden horror swept over him.

"Grenfell!" he said hoarsely. "It's—"

"Of course," Grenfell whispered. "Critical mass."

Then it let go.

It was like Hiroshima, but much bigger. And yet, that explosion did not create The Pit. It was the pile that did—the boron-aluminum lattice which Grenfell had so arduously pieced together from parts bootlegged over the years. Right there at the heart of the fission explosion, total disruption took place in the pile, for that was its function. This was slower. It took more than an hour for its hellish activity to reach a peak, and in that time a huge crater had been gouged out of the earth, a seething, spewing mass of volatilized elements, raw radiation, and incandescent gases. It was—The Pit. Its activity curve was plotted abruptly—up to peak in an hour and eight minutes, and then a gradual subsidence as it tried to feed further afield with less and less fuelling effect; and as it consumed its own flaming wastes in an effort to reach inactivity. Rain would help to blanket it, through energy lost in volatilizing the drops; and each of the many elements involved went through its respective secondary radioactivity, and passed away its successive half-lives. The subsidence of The Pit would take between eight and nine thousand years.

And like Hiroshima, this explosion had effects which reached into history and into men's hearts in places far separated in time from the cataclysm itself.

These things happened:

The explosion could not be concealed; and there was too much hysteria afoot for anything to be confirmed. It was easier to run headlines saying WE ARE ATTACKED. There was an instantaneous and panicky demand for reprisals, and the government acceded, because such "reprisals" suited the policy of certain members who could command emergency powers. And so the First Atomic War was touched off.

And the Second.

There were no more atomic wars after that. The Mutant's War was a barbarous affair, and the mutants defeated the tattered and largely sterile remnants of humanity, because the mutants were strong. And then the mutants died out because they were unfit. For a while there was some very interesting material to be studied on the effects of radiation on heredity, but there was no one to study it.

There were some humans left. The rats got most of them, after increasing in fantastic numbers; and there were three plagues.

After that there were half-stooping, naked things whose twisted heredity could have been traced to humankind; but these could be frightened, as individuals and as a race, so therefore they could not progress. They were certainly not human.

The Pit, in A.D. 5000, had changed little over the centuries. Still it was an angry memorial to the misuse of great power; and because of it, organized warfare was a forgotten thing. Because of it, the world was free of the wasteful smoke and dirt of industry. The scream and crash of bombs and the soporific beat of marching feet were never heard, and at long last the earth was at peace.

To go near The Pit was slow, certain death, and it was respected and feared, and would be for centuries more. It winked and blinked redly at night, and was surrounded by a halo and broken tract stretching out and away over the horizon; and around it flickered a ghostly blue glow. Nothing lived there. Nothing could.

With such a war memorial, there could only be peace. The earth could never forget the horror that could be loosed by war.

That was Grenfell's dream.

THE END.

Brass Tacks

(*Continued from page 98*)

recorded. Music received by FM may be recorded, and FM also requires ultra-high frequencies—42 to 50 megacycles at present, and it is soon to be raised. If television signals, in other words, can be converted into sound, they can be recorded, for, by definition, they are within the 15,000 cycle limit.

If such a record were made, then, it seems quite possible that it could be used to modulate the input of a television receiver so that a picture would be formed upon the screen. What the quality of such a picture would be I have no idea. Certainly it would depend to some extent upon the components of the receiver used, and if recorded upon disks it would certainly not be free from distortion. Such sounds could be recorded at present speeds just as music is recorded and with about the same quality—a good approximation.

However, if such recordings were to be made, I feel that disks would not even be considered, for wire can do the job much better. New alloys are being developed for wire recording which, with high enough linear speeds, will be able to record the entire audible range. There is some question about the upper frequency limit on disks. I believe that no commercial disks have attained 15,000 cycles, though they apparently do sometimes go as high as 11 or 12 thousand, while some say that they never go higher than about 8000. Whatever the upper limit, the big drawback of disks is that it is not constant—very good fidelity is achieved at the outer edge of the disk, while at the center the highs degenerate to noise. This fact, and the relatively short time limit of disks, even at 33 1-3 RPM, has already, doomed the disk record to obsolescence.

Even if such a system were to prove practicable, it does not seem likely that such records, even on wire, would replace movie film. The film method of recording pictures is much simpler and requires a lot less equipment.—William M. Danner, 720 Rockwood Avenue, Pittsburgh 16, Pennsylvania.

The area of destruction caused by an atomic bomb probably increases roughly as the square of the number of years since July, 1945, I suspect!

Dear Mr. Campbell:

Well, Padgett's done it. I never thought he'd match "Mimsey Were the Borogoves," but he seems to have done it. If the second part of "Fairy Chessmen" is as good as the first, it will be a good bet for the best story of 1946. Of course there will be some terrific competition when Heinlein gets back, but still—"Fairy Chessmen" is awful good. This should be a good yarn for Astounding.

It seems to me that stories of a certain type, which you print every now and then, perform a valuable

service in promoting a certain outlook. This point of view is that we practically wallow in potential great discoveries that we can't see because we simply don't know where to look or how to focus our eyes. Some of the best examples of stories pointing this out that I can remember are "The Morons" by Harl Vincent, the Harold Shea epics by de Camp and Pratt, and "Mimsey Were the Borogoves." I wonder how far back the minimum technology for the discovery of electricity existed? The Greeks several centuries B. C. could have built electric batteries and electromagnets, I imagine. They didn't, of course. No one knew where to look.

The trick in finding these new things like electricity and ESP seems to lie mostly in having the attitude that contemporary science certainly doesn't know all the directions in which knowledge lies, and then in looking for things that don't fit into the present-day idea of the universe. Dead frog legs that kick, and so.

Of course there are a lot of discoveries that must wait upon improvements in technology and suchlike. The Greeks couldn't have developed atomic power and radioactivity wasn't likely to be discovered before the widespread use of photographic plates gave a convenient way of detecting hard radiation. But just the same, I'll bet that we're overlooking a lot of first-rate tricks that are within our reach but not our sight.

Aside from the serial, the story I liked best in the issue was "N Day," by Philip Latham. It was neatly done. More, Mr. Latham!

Five years to the Blowup, you say. How about some hints or ideas as to means of surviving it? You could give us some techniques for short-range p r e d i c t i o n—situations that might set it off, and so on, like those symptoms of a coming nova in "N Day." And it might be useful to know the minimum safe distance from cities.

How about it?—William Bade, 1423 Q Street, Lincoln, Nebraska.

If most of the things tried don't work, and the atomic bomb did—wonder what else they tried!

Dear John:

I've just ended three years as a mad scientist inventing secret weapons, and wish to report that conditions in the business differ considerably from those in ASF's stories; they're not so much *worse* as *different.*

In the stories the experiments usually work; in the real thing they usually don't. The real thing involves a lot of waste motion. It's time-consuming: I got so I allowed six months for a little job like tests on a new valve. It's full of ironies: my most confidential project was cancelled for lack of unobtainable nichrome wire. Bureaucrats are much nicer people than Leinster makes out, on the whole.

My slide-rule sheathed and my faithful swivel-chair turned out to grass, I crave controversy. That

smelly object is my glove; won't some Fortean, Atlantean, Pyramidologist, Diffusionist, Anglo-Israelist, Nostradamian, Subjectivist, Heliolithicist, or Euhemerist pick it up? Have at you!

Re Skirvin's letter, ASF, Oct. '44: I'm informed that Eros has in fact caused mixed expeditions horrible complications; so much so that on one such expedition it was considered whether to send the men on one ship and the women on another.

What are the prospects for (a) enlarging ASF, (b) restoring "Probability Zero," and c) reviving Unknown Worlds?

Peace to all sentient beings.—L. Sprague de Camp, Lansdowne, Pennsylvania.

At last—the complete answer to the atomic bomb! It doesn't work because it's physically meaningless—or is it?

Dear John:

Wishing to throw another nut in the machinery, and also drag up a slightly dead cat, I find a basic error in Dr. Einstein's Theories. The friends of Mr. and Mrs. Joe Cauldron left me to go to California with Lewis Padgett and so I am unable to pursue this reasoning myself.

I have been thoroughly lambasted and corrected on the Square of Speed of Light. Period. It is agreed, seconded and passed, that no one can square a velocity.

Now, from what I gather—and from which I blithely took C^2—Einstein's mass-energy relation goes:

$$E = mc^2$$

Now, as Robert Swisher so aptly put it, if you use light-seconds as a unit of velocity, c^2 becomes unity and therefore one gram of mass will give you exactly one erg of energy. All we have to do to make countermeasures for the atomic bomb, therefore, is to see that everybody on earth realizes that even Einstein can't Square the Speed of Light!

Then, of course, the stuff will not be any more dangerous than a slightly radioactive mass of low-grade dynamite.—George O. Smith.

Thanks—but we're just as glad it didn't develop. Besides, with atomic energy, chemical rockets seem unnecessary anyway.

Dear Campbell:

V-2's erratic contrail is still a bit of a mystery. By now you'll have seen the newsreels which show that it goes up as sedately as an elevator, without any hunting or jerking at all. It seems possible that only the *trail* is irregular: quite obviously the rocket itself couldn't follow some of the right-angled bends the photos show.

There's a very common fallacy which I'm sorry to see you've repeated in your note on V-2. *A nose-drive rocket is no more stable than a tail-drive one.* It's not like a pendulum hanging from a support which must be above the center of gravity for stability. If

you consider a nose-drive rocket with the thrust making an angle with the center line, the rocket will keep turning indefinitely *because the misalignment will always remain fixed.* The result is exactly the same if the thrust is applied at the tail. So there's no point whatsoever in putting the motor ahead of the c. g.

Incidentally, the controlling vanes in the jet were made of wood in the later V-2's! I spent an afternoon examining one the other day and sent some of the glass-wool insulation to Willy as a souvenir!

There was an historic gathering in London last month when the Chief Superintendent of Scientific Research at the Royal Aircraft Establishment gave a lecture to a packed audience of the Royal Aeronautical Society, the subject being German long-range rocket development. Handley-Page was in the chair and looking at all the gold-braid around the hall I couldn't help thinking that the rocket had become respectable mighty fast. This was the first time that any information on the transatlantic projects had been released. In case you don't know what was coming to you, von Braun and his boys were going to put wings on a V-2 and sit *that* on top of an 85-ton booster. The first two-step ship, in fact. The bottom step would be dropped at 3,000 m. p. h.—and recovered by parachute—and the top one would go on to 8,000 m. p. h. When it came down into the lower atmosphere it would go into a 2,000-

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mile glide, losing kinetic energy all the time. The total range would have been 3,000 miles, covered in 45 minutes. I won't make myself unpopular by saying it's a pity it never got past the project stage—but you know how the astronauts in this country felt about V-2!
—Flight Lieutenant A. C. Clarke, R. A. F.

But would riflemaking and normal wanderings go together?

Dear Mr. Campbell:

Theodore Sturgeon's radio-script belongs, I think, very near the top of the A-Lab this month. Of course the Smyth Report is undeniably the second most important document in history—guess what the most important was!—but let's confine ourselves to writings of lesser position for the time being.

Norman Corwin finally has an equal—unless Sturgeon *is* Corwin. Sturgeon's script letter has all the clarity of purpose and freedom from BS found in Corwin's best work—and does a better job of explaining the Atomic Age than Corwin has done to date. Honestly, as I read it I could almost hear the background theme of "power power power power atomic power atomic power atomic power" rise to a great thundering roar. One of the few pieces ever to thrill me like music.

I have a bone to pick with Lewis Padgett—why in the name of Dan'l Boone did he "arm the Hedgehounds with bows and arrows! Not even crossbows, but ordinary 75 to 100-pound long bows. Not that I regard the bow as entirely useless, but I just can't possibly picture thousands of Yankee ridge-runners armed with *bows*. What's wrong with rifles?

Now in these degenerate days we picture rifles as semiautomatic regiment-killers, gilt-edge target rifles or spitting twenty-tooze, but there exists the muzzle loading Kentucky Rifle and the men to make it.

The Kentucky Rifle, both in its original form and later as the shorter Plains Rifle, settled this country, and not only because the pioneers had nothing more advanced. A good Kentucky, flintlock or percussion, will shoot closer than a man can hold at ranges up to two hundred yards, and can hit and kill men at six hundred yards. It's been proved over and over again in the past fifteen years by the six thousand members of the National Muzzle Loading Rifle Association.

The average factory gunsmith probably wouldn't be of much use without his Pratt & Whitney hook-type rifling machines, vertical boring mills, Blanchard lathes, etc., etcetera, but the men who make Kentuckies don't need such fancy stuff. Most of them—the recent revival of interest in the old weapons created many and turned up a number of old-timers—still live up Brush Creek or Sawlog Run; out of atomic-explosion range of large cities. They'd

survive any blowup. Like Drega's men in the old *"Three Thousand* Years," they could make their own tools with a knife and an axe.

The percussion method of ignition would probably have to be dropped, although even a very tiny and crude industrial establishment could turn out percussion caps. No matter—there are plenty of flint boulders throughout the country, and a little basic knowledge, quickly acquired, would be enough to reduce them to rifle flints. The flintlock method of ignition isn't at all bad—it even has certain advantages over the percussion. I know, for I've used both—the flying pieces of copper cap hurt like hell.

The only possible point in favor of the bow—its alleged rate of fire—doesn't even hold water very long. Have you ever seen the multi-barrel rifles used as far back as the Revolution? I assure you that a multi-barrel muzzle loader can be emptied just as rapidly as a semi-auto.

During the 1830's and '40's a man named William Billinghurst lived in Rochester. He made a specialty of revolving-cylinder rifles, seven-shot, pill-lock — an early form of percussion lock using pills of fulminate without the nipples and copper caps—sometimes with a shotgun barrel beneath the rifle barrel. Well, a revolving arm can be made without a lathe, but a metal turning lathe doesn't require any power other than that produced by the machinist's apprentice, and it doesn't require slide rests and screw-cutting dinguses. At least, it didn't up until a couple of centuries ago—the Romans had metal lathes, we're told.

So why not give the Hedgehounds a break—bows and arrows are only fit for children and people who've slipped so badly that they probably eat grubs and moths anyway.

I suppose that addicts of archery would rend me to pieces, but West Virginia has allowed deer-hunting with the long bow for three years. The first kill was made this year!

If the blowup came in 1950, how did the bow get established in the first place—the game just isn't plentiful and unwary enough for it any more. Deer might be got with some success by jack-lighting them at night, but imagine trying to shoot running rabbits, or even relatively stationary squirrels. It could be done, but the first Hedgehounds would probably starve before they mastered the bow well enough!—Keith Buchanan. Box 148, Amsterdam, Ohio.

No Second Foundation?!

Dear John:

After reading the last number of "The MULE," and almost freezing my fingers doing so, since the wearing of gloves would have made it impossible to turn the pages, I should like to anticipate Mr. Azimov a little and prophesy.

There is no Second Foundation.

As Ebling Mis has already found

out, the references to the second Foundation are few and far between. Even Hari Seldon himself has referred to it only casually, cautioning Mayor Hardin at the second opening of the vault not to forget that "it is at the other end of the Galaxy." And Seldon is not loath to tell untruths when it suits the purposes of his plan to do so.

The reasons why he instilled the idea that there was a second "foundation" is as follows: At the time of Latham Devers, and even before, there was a tendency for the people of the Foundation to adopt a devil-may-care attitude, and think of their own acts as unimportant. Didn't Seldon himself virtually guarantee that they were to rule the Universe and bring it back to its original splendor? Why should they trouble! Just do what was best for themselves and let the plan take care of itself. Seldon said that the crises came when there was only one thing to do, and nothing else—no freedom of action whatsoever. And they, knowing or unknowing, would do it with little mental effort —although perhaps much physical effort—on their part.

However, there is a possibility that the foundation may be defeated by means unknown to Seldon. Such a thing has happened now, although apparently it is just temporary, as the domination will depart with the Mule. The complete downfall of Seldon's plan and the inevitability of the conquest of the Galaxy is gone. And the spirit of the people will go with it —there is no hope—Seldon is discredited — unless the Second Foundation is found. A little knot of people will band together in that hope, no matter what happened to the First Foundation on Terminus.

In short, the responsibility of regaining the empire is too great to carry—unless one can fall back on the idea if, even if we fail, the Second Foundation will complete the job.

And the reason why Seldon wanted people to think that there WAS a second foundation? I am quite sure that Mis knew the answer before he died. The Mule, conqueror that he was, has spread the Foundation and atomics farther than the Mayors and the Traders ever did. The independent Traders have stopped expanding, they have a much bigger prize to conquer—the parent Foundation. In Riose's time the Empire was still an attractive bait. No more, Trantor has been laid waste and the Foundation controls have the Galaxy. A conqueror will spend his time attracting the richest prize of all —the Foundation. And the Foundation must resist and cannot continue its spread of knowledge through the other half of the Galaxy.

Assume that the Foundation recovers its strength when the Mule is no more. A Foundation at peace will have men that will want to find the other Foundation at the other end of the Galaxy at Star's End. They will hunt for records, as Mis did, and find them obscure.

They will hunt all over the other half of the Galaxy, not finding the Second Foundation, but bringing atomics to every world they search on.

Assume a Foundation restored to strength. A would-be conqueror, reconvinced that there is no hope of defeating, more than temporarily, the parent Foundation will start for the other — spreading civilization, and a knowledge of atomics as he goes.

As you can gather from the above, I am very anxious to find out what really did happen, and if there really is a Second Foundation, and the rest of the tale. Tell Azimov to get going.

For the rest of the December issue:

2. "Beggars in Velvet"

3. "Orders"—this was apparently written some time ago.

4. "Trouble Times Two."

A final request—do *NOT* enlarge the size of Astounding. Keep it the way it is. Fatter, if possible, but no larger—please. As a charter member of Astounding from March, 1930, this request goes out from the bottom of my heart. No Size Increase, Please! ! !—Robert B. Griffin, 219 Washington Avenue, Brooklyn 5, New York.

Both Congress and the Atomic Scientists have trouble in reaching a mutual understanding. Atomic scientists know they have an irresistible force which they understand, and don't trust mob psychology as practiced by na-

tions. Congress understands human nature better, doesn't understand and doesn't trust atomic force.

Dear Mr. Campbell:

Your editorial of January 1946 is an example of the writing I like to see these days. Easy to read, to the point, and factual. The latter is difficult to do in the midst of the jumbled collection of news items that have been sent before us these days in regard to nuclear energy.

Don't underrate Congress on this issue. The MacMahon Committee is sincerely endeavoring to produce some legislation that will adequately cover the situation, today, and with an eye to the future. They welcome any and all communications that may aid them or encourage them. Congress wants its achievements in this field to be a direct reflection of the thinking of the man on the street, their voters. They don't have any precedent to guide them as they usually have on vital issues.

It is up to every one of us to do some individual thinking and fact-finding. I think the chief danger today is that most of us are inclined to listen to the opinions of a few, agree or disagree, and let it go at that.

Periodicals and newspapers can be of great value in aiding "we, the people," to develop and express our ideas. Your editorial, referred to above, assembled a number of items, some very new, that should be part of everyone's current knowledge. Will you continue to help us in your stories and features? Thank you from a worker at Los Alamos.—William H. Lawrence, P. O. Box 1663, Santa Fe, New Mexico.

THE END.

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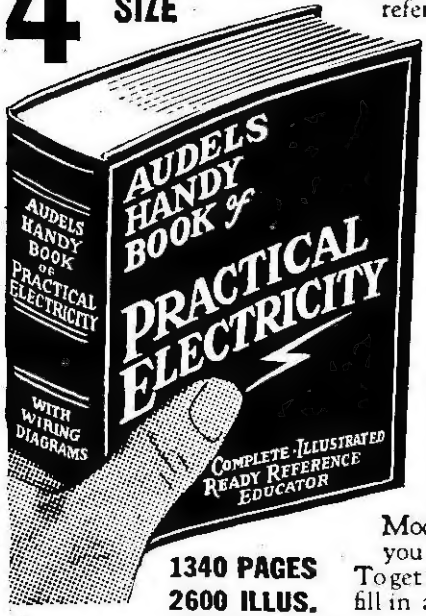
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